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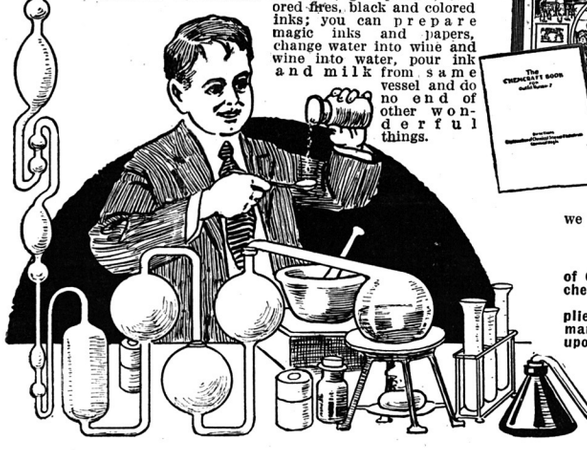

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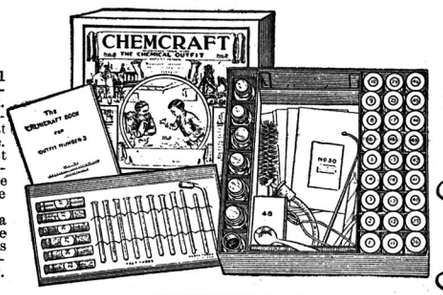

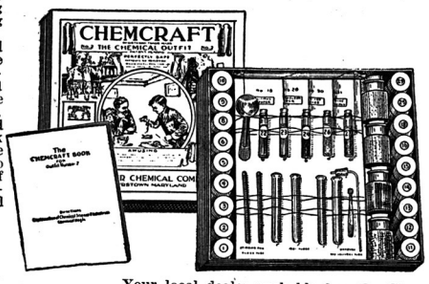

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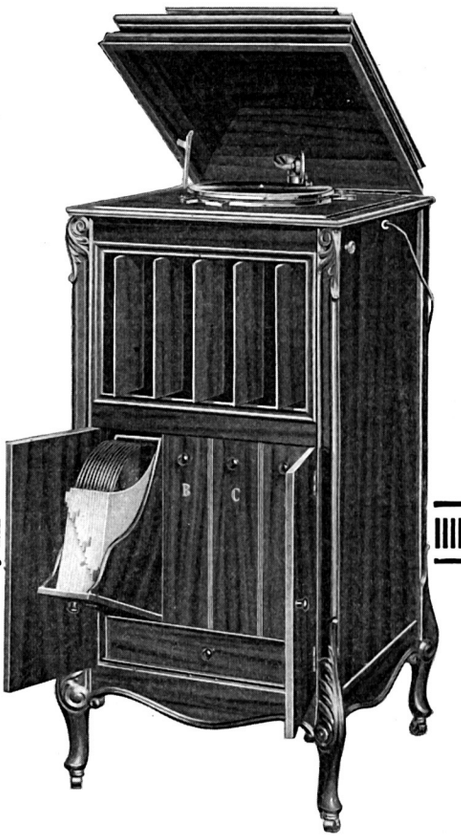

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Vol. V Whole No. 56 DECEMBER, 1917 No. 8

DAYLIGHT SIGNALING WITH SEARCHLIGHT.....Front Cover
From a painting by George Wall
LOCATING THE SUBMARINE BY RADIO..By H. Winfield Secor 509
ELECTRIC BOMB DROPPER FOR AEROPLANES..... 511
RADIUM PAINT IN THE WAR..... 512
ELECTRIC XMAS TOYS 513
DAYLIGHT SIGNALING WITH ELECTRIC SEARCHLIGHT... 514
THE MARVELS OF RADIO-ACTIVITY. PART IV.....
By Jerome S. Marcus, B.Sc. (Ch.E.) 515
HOW I TELEGRAPH PICTURES.....By J. H. Leishman 516
ELECTRICITY AND GOLD FISHES.....By H. Gernsback 518
WOMEN MAKE GOOD RADIO OPERATORS..... 519
A TRACKLESS TROLLEY SYSTEM.....By L. Schoolcraft 522
THE SUBMARINE AND KINDRED PROBLEMS..... 524
A NEW COMBINED STEREOSCOPIC AND FLUOROSCOPIC TABLE 525
MAGNETIC SEPARATOR PULLEY GREAT TIME SAVER....
By F. C. Perkins 526
A REVOLVING ELECTRIC XMAS TREE.....By John T. Dwyer 529
HOW TO USE HIGH FREQUENCY CURRENTS IN THE TREATMENT OF DISEASE.....By Dr. Frederick Finch Strong 530
THE "RADIO ROLL OF HONOR"..... 533
SOME INTERESTING NEW RADIO APPARATUS..... 534
THE AUDION AND THE "EDISON EFFECT"..By George Holmes 536
RADIO TRANSMITTING INDUCTANCES. PART V—THE HOW AND WHY OF RADIO APPARATUS..... 537
THE UNCROWNING OF THE GIMCRACK KING.....
By Thomas Reed 539
THE MYSTERIOUS VOICE.....By C. A. Oldroyd 541
AN ELECTRICALLY PLAYED MANDOLIN—HOW TO MAKE IT.....By McClure Albright 542
AN AUTOMATIC STORAGE BATTERY CHARGER.....
By Lewis Scriven 544
HOW-TO-MAKE-IT DEPT.—PRIZE CONTEST..... 547
WRINKLES, RECIPES AND FORMULAS..Edited by S. Gernsback 549
EXPERIMENTAL CHEMISTRY—19th Lesson.....
By Albert W. Wilsdon 550
"ELECTRICAL LABORATORY"—Prize Contest..... 551
LATEST PATENTS DIGEST..... 552
PHONEY PATENTS—CONTEST 553
QUESTION BOX 554

SOLAR "HEAT"

WE may take it as an established fact that the sun is a huge ball of incandescent matter. Spectral analysis shows that the sun contains every element known to us as found on the earth. Every metal, every gas is represented in the incandescent photosphere, *i.e.,* the gaseous envelope surrounding the sun, burning at a tremendous heat.

We know the sun to be some 93 million miles distant from the earth. Enormous as this distance is—incomprehensible to the human mind—we receive daily from our luminary a quantity of energy nothing short of astounding. Only by remembering that a light-ray traveling at a speed of close to 186,000 miles per second, requires a little over 8 minutes to traverse the gulf separating the sun from the earth, do we begin to realize what sort of a problem we face, when we wish to make it clear to our minds how such a stupendous energy, which lights and heats our planet, is conveyed to us thru a vacuum. For the odd 93 million miles separating the sun from the earth constitute of course an almost perfect vacuum. Nevertheless the earth is lighted and heated. But how does it come about?

Now we know that if we go only 30 miles above the surface of the earth, we strike a temperature of —273 degrees *Centigrade,* the absolute zero of interstellar space. Nevertheless, heat in *some form* gets thru this tremendous cold, paradoxical as this sounds at first. Otherwise, how do we account for the earth being heated by the sun? If you doubt that it gets colder as you go up, you have but to climb a mountain of moderate height. Even three miles up the cold becomes so intense that the top of the mountain will be found covered with perpetual ice. Notwithstanding this, we are closer to the sun by 3 miles at the summit than at the base of the mountain! Also we find by way of further proof that if we expose a thermometer directly to the sun's rays at the top of the mountain, the temperature will be about the same as that of the ice at our feet. And it makes little difference if we perform this experiment on an ice covered mountain at the equator, or on a similar mountain in more northern latitudes.

Logically then we are forced to the conclusion that we do not receive heat rays from the sun at all. For the dark heat rays can not pass thru a vacuum. By placing a thermometer in an ordinary Thermos bottle this statement can be verified readily.

But where does the heat come from? How is the earth heated after all, for heated it certainly is?

By the sun's *light rays.* We know these rays not to be merely luminous rays, but they are in reality electro-magnetic rays. Now then, when these cold rays strike the earth's atmosphere at its lower strata, where the latter is heavily comprest, to some 15 lbs., per square inch, these cold light rays seem to undergo a transformation, and in the act greatly heat the surrounding air. Just what this transformation is we do not as yet know, mainly because we do not actually know the true composition of a light ray. We don't know what lies beyond the ultra violet, nor the ultra red section of the sun's spectrum. Nor do we know much of the light rays' electrical structure.

At this point we wish to make an interesting reflection. Not so long ago the famous Dutch philosopher Dr. Kamerlingh Onnes made certain experiments of tremendous import. He placed an electrical conductor in an almost absolute zero, and found to his astonishment that a current started in such a conductor would continue to flow *for* 19 *hours.* The tremendous cold robbed the conductor of all its former resistance, and the electric current finding no resistance to wear itself out in heat, became a sort of perpetual circuit, which lasted as long as the conductor was near the absolute zero.

Now the point is, the space separating the earth from the sun is at an absolute zero. Is this not perhaps the reason that the sun's light-rays which are of course electrical in nature—act in a like manner to the electric current in Dr. Onnes' experiments? This then would explain, why practically no energy is lost in the transmission thru 93 million miles of icy space.

H. GERNSBACK.

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There have been other electrical experimental outfits on the market thus far, but we do not believe that there has ever been produced anything that comes anywhere near approaching the new experimental outfit which we illustrate herewith.

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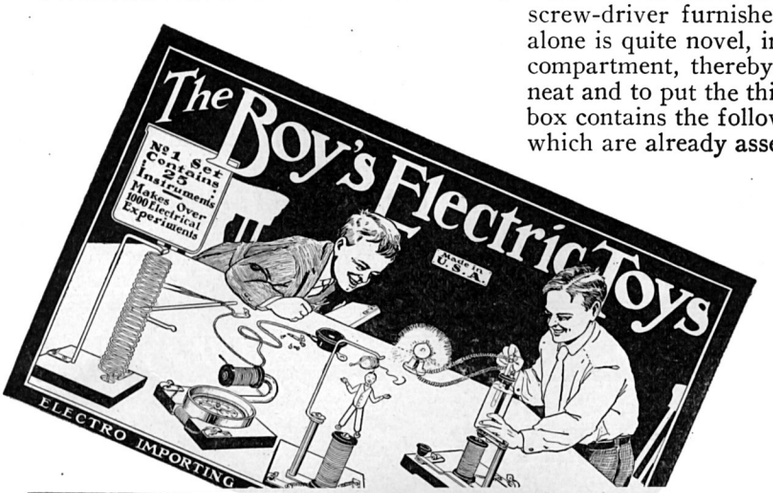

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This does not by any means exhaust the list, but a great many more apparatus can be built actually and effectually.

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The outfit contains 114 separate pieces of material and 24 pieces of finished articles ready to use at once.

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Among the finished material the following parts are included:

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THE ELECTRICAL EXPERIMENTER

H. GERNSBACK EDITOR
H. W. SECOR ASSOCIATE EDITOR

Vol. V. Whole No. 56 December, 1917 Number 8

Locating The Submarine by Radio

By H. WINFIELD SECOR

WHILE there have been hundreds of schemes proposed in the past few months, for the detection and destruction of submarine warcraft, there have been but very few really practical suggestions in the total number.

The present discussion deals with a new wireless scheme for detecting the presence of submarines as far as two miles away from a given base, which may be either on a ship or on land. Credit for this submarine detector is due to Mr. Leon W. Bishop, who is now associated with a staff of experts engaged in solving military and naval problems. Mr. Bishop invented the well-known *multi-audi-phone* radio and telephone amplifier.

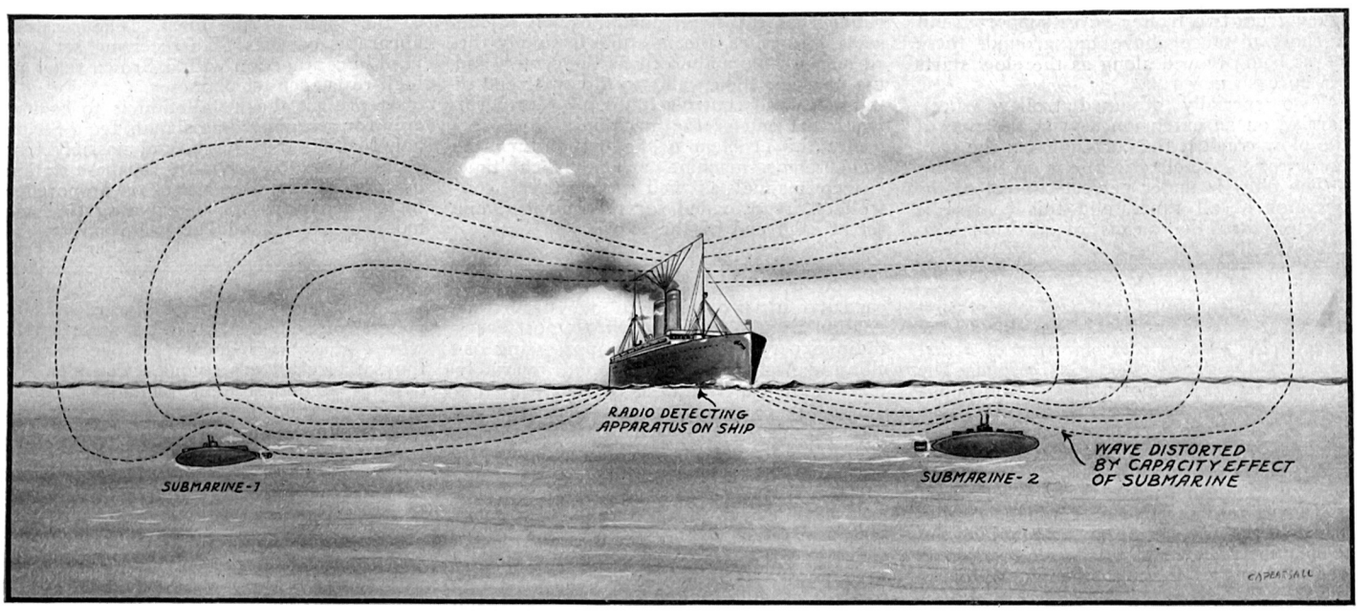
Mr. Bishop has done a great deal of experimenting with microphones for the detection of submarines and has evolved a number of very ingenious and advanced types of microphones, especially suited to these requirements, and for which purpose the ordinary microphone is practically worthless. At the present time very favorable results are being obtained with microphones for this purpose, but several problems have yet to be solved in order that these sound-sensitive devices will perform their functions under water properly in order to accurately spot the "Hun" in his stealthy U-Boat.

Among the different forms of subaqueous microphones devised by this inventor is one mounted in a special resilient substance so as to keep it free from ordinary vibrations and noises. Particularly has he devised special circuits for using microphones in this work whereby they are electrically balanced. He is also experimenting with microphones which produce direct current pulsations, thus conducing to the elimination of external noises.

Coming now to the wireless scheme for the detection of submarines, whether submerged or not, over ranges of two miles and more, (depending upon the wave length used), the general idea of the action taking place will be gleaned from the accompanying illustration. A vessel is here shown radiating a wireless wave of say three thousand meters length, which is equivalent roughly to two miles. Also for the purpose of bringing out the efficiency of the scheme more fully, two submarines are shown and also their effect upon the radiating wave from the antenna.

The inventor of this means of detecting enemy sub-sea boats, received his first demonstration of the ultra-sensitive electrical action involved while operating an undamped Audion receiving set some months ago, and which effect is quite well known.

It was found that when the Audion receptor was suitably tuned, so as to produce a regenerative effect, *i.e.*, producing radio frequency oscillations, that at certain times a peculiar sound effect could be noticed in the telephone receivers connected to the circuit. For sometime this change in the circuit, as manifested by the sound in the telephone receivers, remained an un-



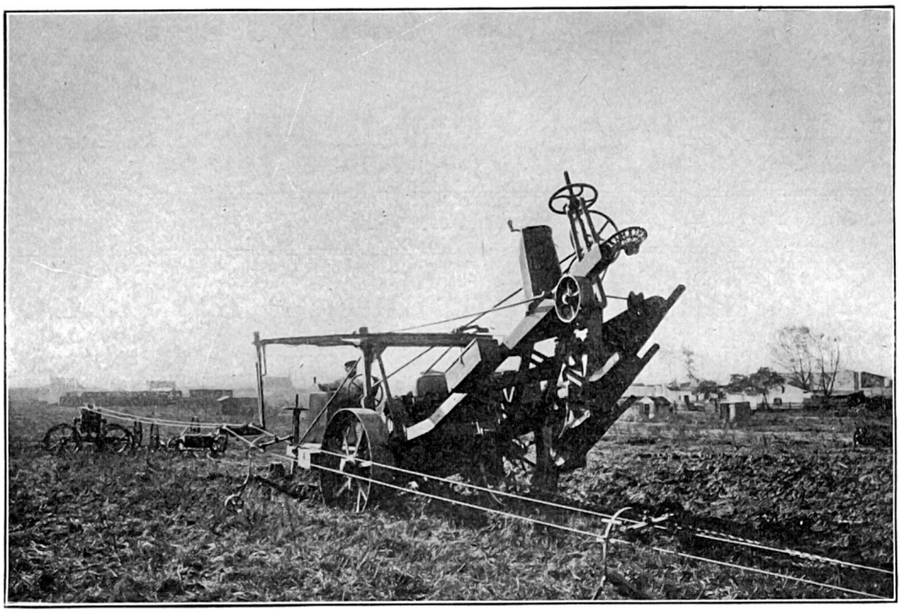
This Radio Wave Method of Detecting and Locating Submarines and Even "Torpedoes" Has Been Tested Out and Gives Surprising Results. It Is Effective up to Two Miles and More and the Enemy Cannot Evade Its Action, so Long as "Subs" Are Made of Metal.

ELECTRIC PLOWING IN GERMANY.

The German farmers, being very hard prest in tilling large tracts of land with an heretofore unknown shortage of labor, have made extensive use of large electric plows and other agricultural machines, one of these immense plows being shown here.

Electrically operated agricultural machines of this type have been used for a number of years on German farms, the electric light companies distributing current for the purpose over very extensive areas, the current being transmitted at very high potentials, often in the neighborhood of 70,000 to 100,000 volts for distances of 75 to 100 miles and more.

In some cases current is supplied to each individual machine by means of trolley poles, which make contact with trolley wires supported above the field under cultivation. In the installation here illustrated, current is taken from two trolley wires supported but a short distance above the ground, these wires being moved along as the plow starts off on each new run.



The Teuton Tillers of the Soil Make Extensive Use of Electrically Operated Plows, One of Which Is Illustrated Above. Current Is Supplied the Motor Thru a Trolley Wire.

Two specially designed trolley wheels carried on an extension arm at the side of the plow conduct the current from the trolley wires to the electric motor on the plow.

The plow is under perfect control of the operator at all times, and this control is effected thru the means of a drum controller, similar to those used on trolley cars and small electric locomotives. These controllers, of which there are two, can easily be seen in the photograph here reproduced.

This particular machine possesses several novel and unusual features, one of which is the fact that at the end of one run across the field, during which it cuts several furrows, the machine is simply tilted up with the main axle as the center, and the operator then walks to the other end of the plow and controls it on the return run from that end of the machine. This overcomes the problem of having to turn the cumbersome machine around each time.

Two manual as well as electrical controllers are provided for this purpose, one set at each end of the plow.

Probably there is no country in the world in which vast numbers of gigantic machines have been so extensively applied for cultivating and harvesting crops as in the western part of the United States, but in the application of electrically-driven machines for accomplishing farm labors on a titanic scale, the Teutons have far out-distanced other countries.—*Photo courtesy Society for Electrical Development.*

RADIO STATION FOR HONGKONG OBSERVATORY.

A receiving installation for the radio station, Royal Observatory, Hongkong, is now being constructed. The station is located at the observatory, in latitude 22° 18′ 13″ N., longitude 114° 10′ 15″ E., of Greenwich. The installation consists of a single triangular steel-lattice mast 150 feet high. The aerial (which is on order in America) will spread from the mast to six chimney stacks of a terrace of houses 150 yards to the south of the mast. The receiving apparatus consists of a receiving set to be used in conjunction with a Brown relay and high-resistance telephones.

At present the installation is to be used only for receiving time signals from Shanghai, Manila, and Hanoi, and possibly from Tsingtau and one or more Japanese stations by night. After the war it is proposed to install apparatus for distributing time signals via Cape d'Aguilar radio station.

---

solved problem, but by careful observation it was ascertained that this was due to the effect of *a passing railroad train at a distance of about one quarter of a mile.* The railroad tracks did not approach the building in which the wireless receptor was located, and therefore it was decided upon that the *capacity effect* of the steel railroad train on the wave radiated by the antenna, was sufficient to change this wave in such a manner that the change could be readily noted in the translating apparatus, *viz.,* the telephone receivers in this case.

By looking at the accompanying illustration it will be seen how the presence of a submarine, whether submerged or not, will cause a reaction on the radiated wave from an antenna located on a ship or on shore.

Mr. Bishop has actually tried this out successfully over considerable distances, and has found that it is possible to detect the presence of not only a submarine a mile or so away, but even the presence of a *torpedo;* so ultra-sensitive is this method of locating a metallic body.

Moreover, the direction in which the metallic body lies may be ascertained by the use of a directional antenna, in somewhat the same manner as the wireless compass scheme.

This effect of bringing any form of capacity in proximity to an oscillating Audion circuit is well-known to most every radio experimenter. Those possessing oscillating Audion sets have found invariably that all of the circuits associated with this device are extremely sensitive to such effects. Even an approach of the operator's body, or for that matter his hand, toward the apparatus upsets the electro-static balance of the circuits. Some of the sets used have proven so sensitive in this respect that it became absolutely necessary to attach long insulated extension handles, sometimes two feet long to the various condensers and tuning switches, so as to eliminate as much as possible this untoward capacity effect of the body.

The accompanying diagram showing connections of Audion oscillator circuits as well as a third, or Audion detector circuit, suitably equipt with telephone receivers, gives an idea of the apparatus employed by Mr. Bishop in some of his researches along this line. Assume for instance an Audion oscillator with its proper capacity and inductance circuits all connected to an antenna as shown. This causes the antenna to radiate radio-frequency waves of a length depending upon the capacity and inductance in the circuit.

We may assume for example that the circuit is tuned to radiate a wave of 3,000 meters, or roughly two miles wave length, which gives a frequency of one hundred thousand cycles per second. Consider also that the second Audion oscillator circuit is set in operation in inductive relation to the first circuit, which is connected to the antenna. The second or inductively associated Audion oscillator is tuned to the same frequency or one hundred thousand per second. Further we note that there is a third coil inductively related to the oscillating circuits and which connects to the Audion detector and a pair of sensitive radio telephone receivers.

Now, if a submarine lies within detecting range, say a mile away, and the antenna is excited by the Audion oscillator No. 1 with a wave having a periodicity of one hundred thousand cycles per second, then its frequency will be slightly changed by the *capacity effect* of the submarine. Suppose it causes the oscillation frequency of the antenna system to change from 100,000 cycles to 101,000 cycles. If such should be the case, then there will be produced a beat frequency note in the third or detector circuit, having a periodicity of *one thousand cycles per second,* which is of course an audible frequency, and therefore

(*Continued on page* 572)

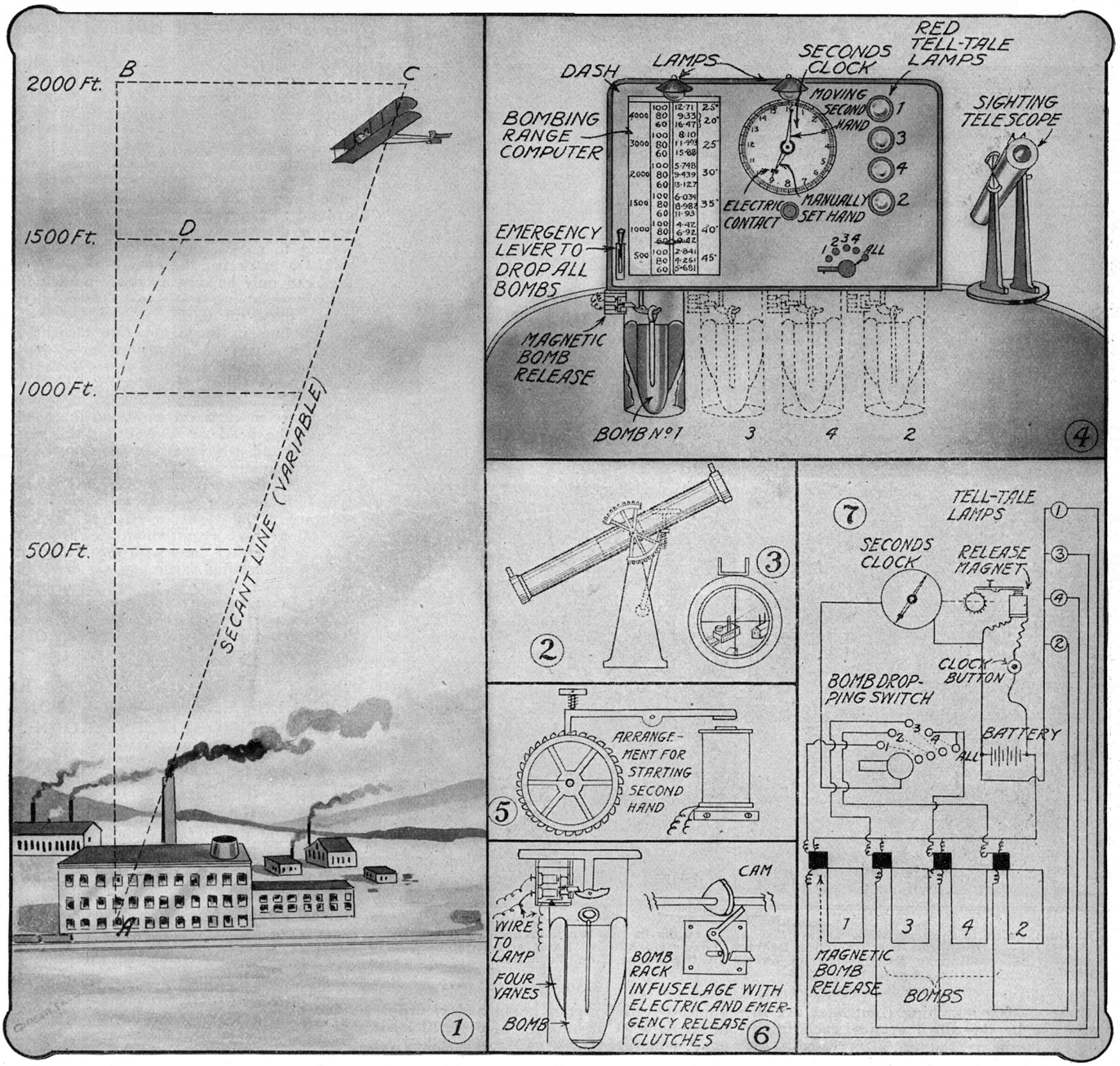
BACK NUMBERS!—Many readers desire to obtain back numbers of this journal. We have a limited quantity of these back issues on hand and can supply them at the following rates:—Back numbers of The Electrical Experimenter not over three months old, 15 cents each; over three months old, 20 cents each; over one year old, 35 cents each.

New Electric Bomb Dropper for Aeroplanes

BOMB dropping from aeroplanes can only be approximately accurate. It can be made at least seventy-five per cent more efficient by sighting and releasing the bomb by mechanical means and eliminating guess-work, as there is only one aviator out of five hundred that is really proficient in the work without some mechanical aid. One of the best bomb sights in use by the Allies is the C. F. S. (Central Flying School) in the British service. The sighting is done over two bars arranged vertically, one above the other, about six inches apart. The third is fixt in a slide, level with the upper sight, thus forming a right angle triangle, with the right angle forward and upward. The slide is graduated into seconds. The aviator decides in what direction the wind is blowing and in order to ascertain the speed at which he is flying, he picks out some object on the ground, having first set his slide at the altitude he is flying, taking a sight along the hypothenuse formed by the two bars of the sight, and as soon as the object comes in line he presses his stop watch, keeping the sight all the time on the object he has selected, until it comes in line with the two vertical bars of the sight. He then reads the time on his watch and adjusts his index slide to read that time.

But the great difficulty with this sight is that at a high altitude, or at night, it is very difficult or nearly impossible for the aviator to discern his object at all.

A Yankee genius, Mr. F. R. Lewis, has overcome this deficiency by employing a telescope mounted on a tripod or base, swiveled and hinged to turn vertically or horizontally, with quadrant and hand-screw to keep it in the desired position or angle, Figure 2. It is designed to have day lenses made interchangeable with night lenses, each provided with cross-hairs, and external locating sights, Figure 3, as it is very difficult to focus an object on the cross-hairs of the telescope, even when flying at sixty miles an hour, until after the object is located.

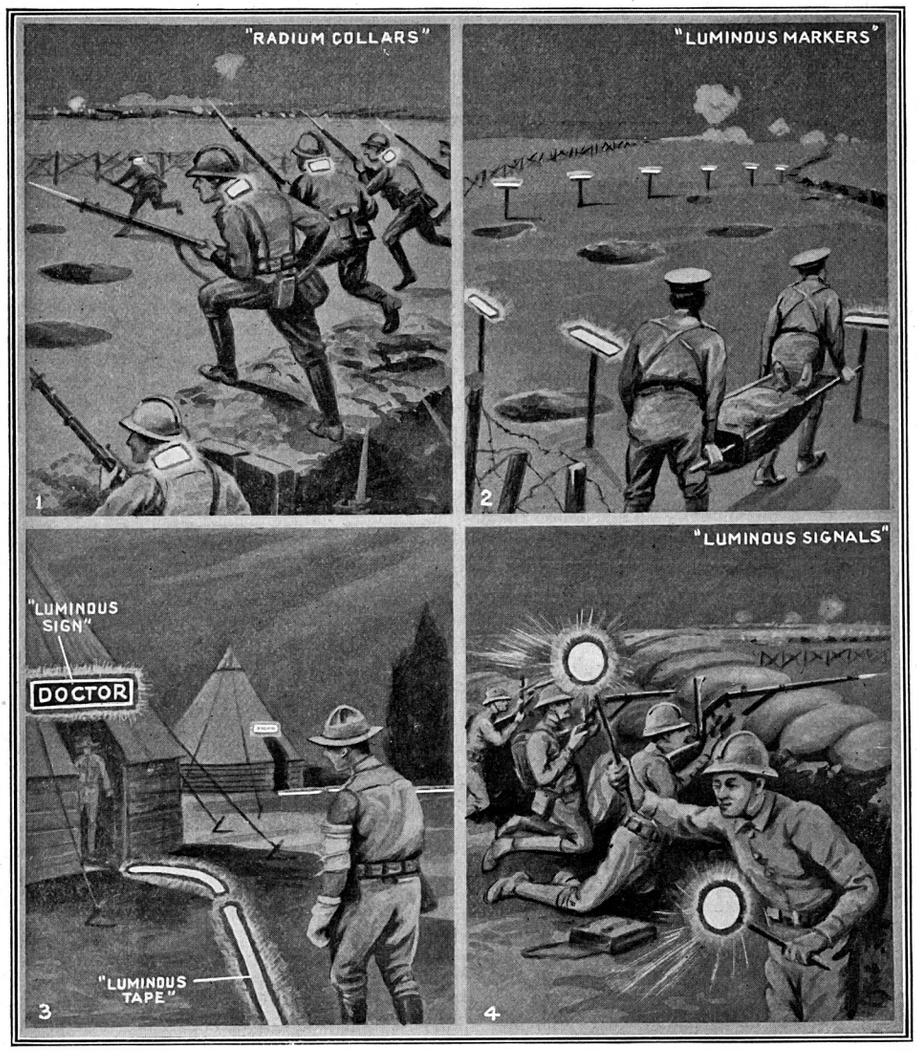


A Yankee Inventor Has Perfected the Simple Electric Bomb Dropper Here Illustrated for Use on Aircraft. The Aviator Checks up His Actual Flying Speed, Sets His Range-finding Telescope and Flies Over the Target. At the Proper Moment the Automatic Electric Clock Switch Releases the Bomb.

(*Continued on page* 754)

Radium Paint in the War

THE persistent electrical activity of radium, especially when used in combination with zinc sulfid, which gives rise to a luminous effect which is readily noticeable in the dark, has led to the adoption of this peculiar mixture for many different uses in the great world war. A large English concern has been extremely busy of late turning out these "luminous paint" articles for use by the soldiers and sailors of His Majesty the King.



Radium Paint Is Finding Many Diversified Applications in the World War. In the Form of "Beacons" It Guides the Stretcher-Bearers Thru "No-Man's" Land and Enables Signaling to Be Carried on Safely in the Front-Line Trenches.

Over 100,000 marching compasses are in daily use by the allied armies, each fitted with a luminous radium dial readable at any time, even on the darkest night. Aeroplanes skim along thru the night, the aviators guided by radium be-dialed compasses. At sea, the doughty little "sub" destroyers shoot hither and thither with never a light to be seen—the radium lighted compass dial answers the question. The man using it can see the dial all the time, but you cannot. Fig. 1 illustrates a clever use for "luminous paint" collars. These linen tabs present a luminous surface of 10 square inches, and are for attachment to the back of the tunic, so that when the first line of men go over the top, they will not be mistaken for enemies in the dark by the second line of men who follow.

The illustration, Fig. 2, shows a most useful beacon provided with a spike to be driven in the ground. They are also made in the shape of large buttons, the luminous painted top being covered with transparent celluloid, and surmounted on a small steel spike ⅜-inch long, which, by pushing, enters into any woodwork, and when affixt to the top of short stakes driven into the ground and placed 10 yards apart, afford a guide to relief parties going and returning in the dark. One hundred of these 10 yards apart will serve 1,000 yards, the stakes being placed in the day on chosen fairly level ground.

One of the most useful articles for dark night operations is "luminous tape." This tape, if placed on the ground and secured by stakes, metal rods or stones, is prevented from being shifted by the wind. The "tape layer" places the tape in position during the day, choosing a safe path across the country, and diverting from the straight path according to the condition of the ground. The path should be wide enough for men to march four abreast up one side of the tape and returning the other side, say, in all about 12 feet wide. Where this is not possible the tape layer makes a break in the tape every few yards, and starts again continuously when the path is wider. Any obstacle in the way, such as a tree or post, could have a small length of tape tied around it (see Fig. 3).

Should a ditch come across the path he would lay short pieces of the tape at right angles on either side of the ditch. In case of the ditch being over 4 feet deep, the man should have a luminous beacon with him and write on it the depth of the ditch, also the width, with a special pencil, and place it by the tape, when near the ditch.

It is readily possible to form large letters out of this tape by nailing it up with zinc nails. Such signs as "Fireman," "Doctor," etc., also direction arrows prove extremely serviceable, see Fig. 3.

The luminious tape is also very useful for the work of the medical corps—the tape-layer by daylight choosing fairly level ground to guide the stretcher bearers—thus saving their labor in the dark, with less jolting to the wounded. Moreover, lamps afford a mark for the enemy—whereas the tape can only be seen by those *immediately over it*—enabling work to be done silently in the dark, the darker the better.

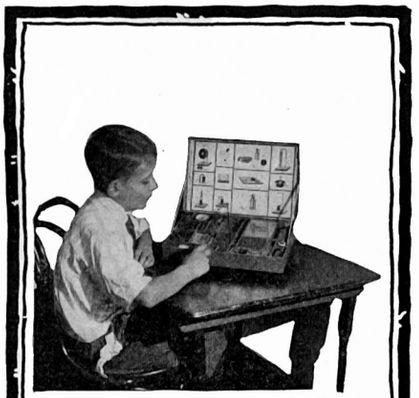
Signaling in the front line trenches at night is always a precarious undertaking. Luminous paint beacons have been used very successfully for signaling silently by night. They are specially useful in trenches which are in close proximity to the enemy, saving the need of whispering the words of command, which causes a hushing sound, when complete silence is required for listening to the enemies' movements. These luminous beacons will carry a message a distance of 20 yards or 60 feet; sufficient for all average requirements. The signaling can be either done with the Morse code or by describing large capital letters of the alphabet the reverse way, and by the hand waving them in the air. The Royal Engineers of the English army are said to have been the first to use these novel, yet wonderful signaling devices.

TO TELEGRAPH PHOTOS BETWEEN BERLIN AND CONSTANTINOPLE BY KORN SYSTEM.

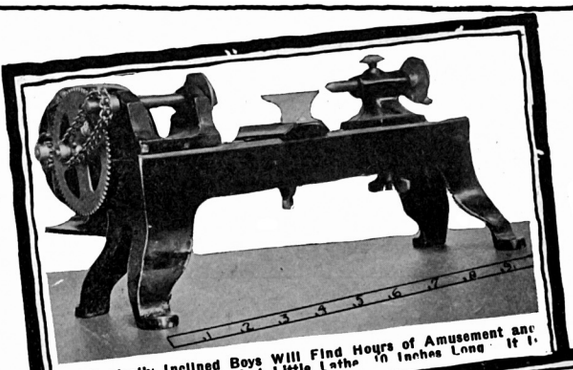
It is reported that Dr. Korn, the eminent German scientist, proposes to introduce his system for the telegraphic transmission of pictures on the Berlin-Vienna-Sophia-Constantinople-Bagdad route.

For this purpose either telegraphic or telephonic connections can be utilized. So far as telephone connections are concerned, one could conceive stations at Vienna and Budapest in connection with Berlin, the lines being occupied for a quarter of an hour only. In these circumstances pictures of an event taking place in the afternoon could appear the next day in the Vienna journals. Transmission for longer distances, such as from Berlin to Constantinople, would involve the use of telegraphic lines, which would enable an ordinary photograph to be transmitted in about an hour. The chief expense involved is the occupation of telegraph and telephone lines between such distances, but it is thought that the governments of the four countries concerned might grant very moderate rates if the lines were only used during hours when there is little or no traffic.

ELECTRIC XMAS TOYS

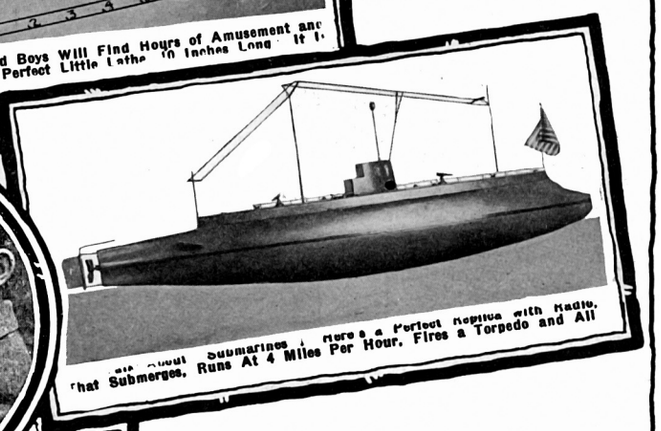


This Experimental Electric Outfit Contains 24 Pieces of Apparatus, Accompanied by An Instruction Book, Which Will Charm Any Boy for Days. The Owner Makes His Own "Juice." Explicit Examples Are Given for Making 1000 Different Experiments, Each One Illustrating Forcibly Some Important Electrical Law.



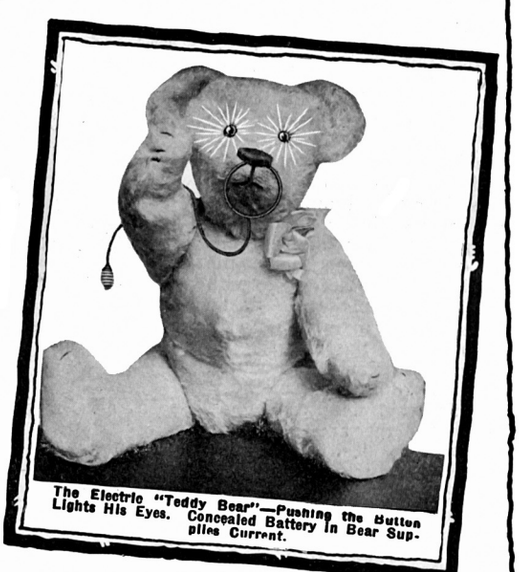
Mechanically Inclined Boys Will Find Hours of Amusement and Instruction In This Perfect Little Lathe 10 Inches Long. It Is Driven by An Electric Motor.

Every Boy Will Enjoy a Toy Telephone

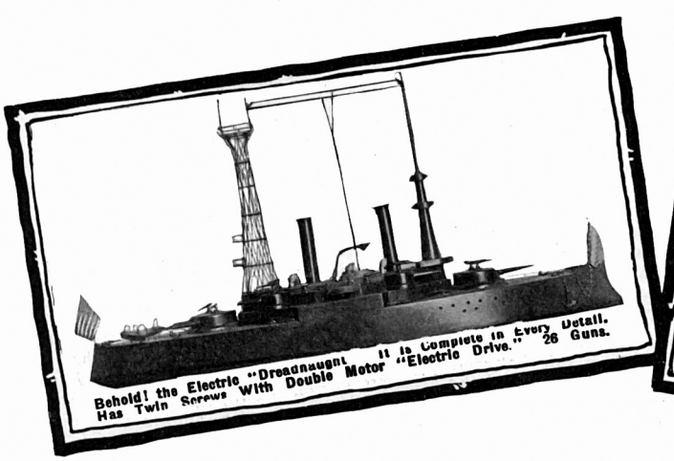


That Submerges, Runs At 4 Miles Per Hour, Fires a Torpedo and All

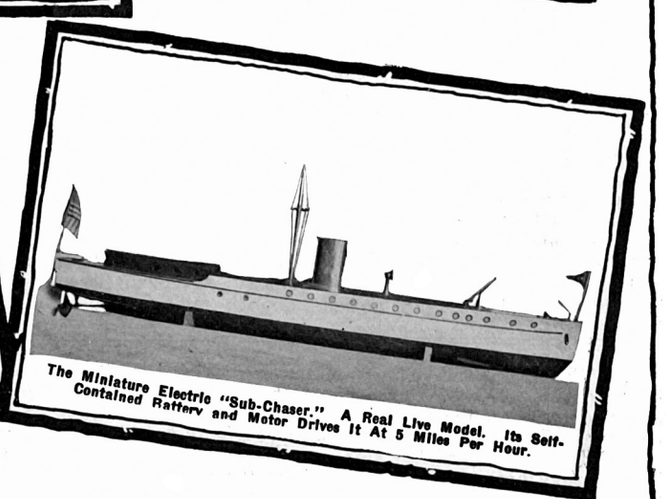
A Real Xmas Delight for Boys and Girls. This Toy Electric Stove Really Bakes Like Mother's. Perfectly Safe and Attaches to Any Lamp Socket.



The Electric "Teddy Bear"—Pushing the Button Lights His Eyes. Concealed Battery In Bear Supplies Current.



Behold! the Electric "Dreadnaught"—It Is Complete in Every Detail. Has Twin Screws With Double Motor "Electric Drive." 26 Guns.



The Miniature Electric "Sub-Chaser." A Real Live Model. Its Self-Contained Battery and Motor Drives It At 5 Miles Per Hour.

Daylight Signaling With Electric Searchlight

WHILE the electric searchlight is used very often for signaling purposes at night, by means of a suitable shutter device, enabling the operator to send out short and long flashes of light corresponding to the signals of the telegraphic code, it seems somewhat paradoxical to think of signaling in broad daylight with a small electric searchlight.

Such is the case, however, as the accompanying photograph tends to corroborate, this particular illustration showing a member of the French Signal Corps in the act of signaling to an aeroplane in flight.

While very efficient wireless communication apparatus have been developed for aircraft requirements, the range is somewhat limited under certain conditions, and this improved scheme of signaling in daytime as well as night, for carrying on communication between two or more aeroplanes or between an aeroplane and the ground, comes as a very welcome auxiliary to the aforesaid means of signaling gun ranges, etc.

As our front cover illustration shows, as well as the accompanying official photograph, the miniature searchlight used for carrying on communication by means of short and long flashes of light corresponding to the dots and dashes of the telegraphic code, is a very simple affair, and not as cumbersome as might be imagined off hand. When the searchlight is to be used, it is held in the hands of the operator in such a manner that it will bring the telescope into sighting position, the telescope member being attached to the top of the searchlight frame. The operator then aims the searchlight at the aeroplane with which communication is to be establisht and maintained. He then transmits the message by means of a telegraph key mounted on the side of the searchlight.

In this way, long and short flashes of light are sent out, spelling out the desired words or numerals in the telegraphic code. The telescope enables the operator to see the distant flashes of the answering light beam from the aeroplane, and thus it becomes possible to carry on communication both ways.

The searchlight is operated from a portable storage battery, which is contained in the carrying case, shown in the illustration, the case being provided with suitable rheostat and control switches, so that the light may be burnt constantly at the highest efficiency.

The entire outfit, altho it has a range of 10,000 feet or approximately two miles in broad daylight, and about twice this range at night, is very light in weight. It might be imagined that such a beam of light used for important and secret communication with a signal corps post on land, might be intercepted by the enemy, but such is not the case, and besides if such a state of affairs should happen to occur, it is quite possible that the enemy would not gain much valuable information. This is so for the reason that these messages are sent in a special cipher, and moreover the make-up of the code is changed frequently.

In order that the aviator may know where to look for these visual signals, the land operator is stationed near a sort of tent, made of four brightly colored cloth strips, as portrayed graphically on our front cover. From above, these strips appear as a bright cross, visible from a great height. Below, on the ground is placed another piece of cloth showing the aeroplane insignia, in this case the newly adopted red central spot on a white field, surrounded by a blue star—the American colors.

Photo © By International Film Service

The French Army Has Recently Perfected a Miniature Searchlight and Telescope for Signaling To and From Aircraft in Daylight, as Well as at Night. It Has a Range of Two Miles in Broad Daylight.

The winds at Curacao are so steady that three wireless stations depend upon wind mills for power.

GRAVITY REVERSED.

Absolute proof that the gravitational attraction between masses of matter varies with changes in their electrical potential due to electrical charges upon them has been obtained by Dr. Francis E. Nipher in a whole year of experiments in the private laboratory of Washington University, St. Louis, financially backed by the Carnegie Institution.

Dr. Nipher is one of the greatest authorities in the world on electrical measurements and the nature of electric currents.

He suspended two spheres of lead, one inch in diameter, from silk fibres about 5 feet 8 inches long inside an insulating screen specially constructed of wood, metal, cardboard, wax and glass, with a layer of air in the middle, and cut off radiation from the sky and all changes in temperature. Spheres of lead ten inches in diameter were adjustably mounted below and a telescope was set to peer thru a slit in the screen, opposite to a specially designed scale.

An influence machine, driven by a single phase motor, was used for varying the electrical potential in the lead spheres.

Dr. Nipher not only diminished the gravitational attraction by charges of electricity upon the large spheres, but he reduced it to zero and then turned it into repulsion. He was able to measure this repulsion, and at times it reached a decrease of 250 per cent in the normal value of the gravitational attraction.

HIST! GERMAN RADIO SPIES.

The wireless operator at division headquarters at one of the National Army camps got a shock recently that will not be duplicated until the troops start "over the top."

He was playing idly with the condensers of his apparatus trying to pick up a word or two from Arlington or Honolulu and not getting much when the receivers began to crack:

"C-Q" came the general call. "C-Q"—"C-Q."

And the character of the spark showed that the sending instrument was close at hand. All the sleuths of the signal corps prepared to chase this interloper to his lair.

He began to have visions of illegal plants hidden in the bayous of the gulf coast—of spies carrying on their work under the very fence of the camp.

"Who are you?" he flashed at once. "By what right are you operating a radio?"

It's hard luck to spoil a thrilling story like this, but right here the whole plot blew up.

"I'm Jones," came the answer at a rate of about 20 words a minute. "I'm Jones, sending from the 124th field artillery—use of set approved by Lieutenant-Colonel H. B. Hackett. Nice evening, isn't it?"

DATE OF ISSUE.—*As many of our readers have recently become unduly agitated as to when they could obtain* THE ELECTRICAL EXPERIMENTER, *we wish to state that the newsstands have the journal on sale between the twelfth and the eighteenth of the month in the eastern part of the United States and about the twentieth of the month west of the Mississippi River. Our subscribers should be in possession of their copies at these dates. Kindly bear in mind, however, that publications are not handled with the same dispatch by the Post Office as a letter. For this reason delays are frequent, therefore kindly be patient and do not send us complaints as to non-arrival of your copy before the twenty-fifth of the month.*

The Marvels of Radio-Activity

By JEROME S. MARCUS, B.Sc. (Ch. E.)

PART IV. (Conclusion.)

Heat Emission of Radio-Active Matter.

IN 1903, it was shown by Curie and Laborde that a *radium compound* was always hotter than the surrounding air and radiated heat at a constant rate of 118 gram calories per hour per gram of radium. This means that a gram of radium, or 0.0028 pound, will boil about 0.0045 pound of water every hour. Enough radium properly contained, would run a boiler continuously with only the addition of water. There is now no doubt that the evolution of heat by radium, and other radio-active substances, is a secondary phenomenon resulting mainly from the expulsion of *alpha* particles. Since the latter have a large kinetic energy due to their high velocity, and are easily stopt by matter, they are absorbed by the radium itself or its immediate container, and the energy of motion is converted into heat. From this, the evolution of heat is proportional to the time and number of alpha particles expelled, as the kinetic energy transformed is in turn dependent on the expelled particles. Rutherford and Barnes first confirmed this view by their experiments. They showed that emanation and the following products were responsible for about three-fourths of the heat evolved by radium in equilibrium.

The heating effect decays with the activity, as observed in studies of emanation. The products radium A, and radium C, each have a heating effect proportional to their activity. Measurements of the heating effect of thorium, uranium, pitchblende, and polonium have been made, the evolution of heat being in each case proportional to the kinetic energy of the alpha particles.

An enormous amount of energy accompanies the transformation of radio-active matter where alpha particles are emitted. It must be remembered that these particles are themselves matter, as was said before, and hence have energy when traveling at a high rate of speed, just as does a thrown baseball, for example, the emanation from one gram of radium in equilibrium, with its products, emits heat initially at the rate of 90 gram calories per hour. The total heat emitted during its transformation is about 12,000 gram calories, enough heat to change 0.12 pound of ice into steam. Since the initial volume of the emanation from one gram of radium is 0.06 cubic centimeters, one cubic centimeter of emanation will emit during its lifetime 20,000,000 gram calories of heat. Now taking the atomic weight of the emanation as 222, one gram, or 0.0022 pound, of radium emanation will

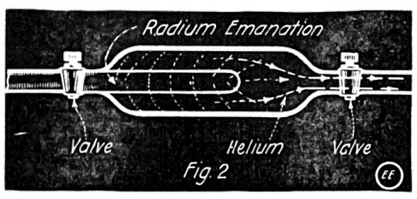


Fig. 2.—Apparatus Used In Producing Helium from Radium Emanation. The Alpha Rays Pass Thru the Thin Glass Inner Wall and Produce Helium.

give off 2,000,000,000 gram calories of heat.

Let us assume a boiler that evaporates 100 pounds of water per hour at normal boiling point and atmospheric pressure, the temperature of the water to be 15° C, or 60° F. Then, neglecting the absorption of heat by the boiler itself, the heat necessary per hour will be 100x (100—15) x1000/2.2. or 3,863,000 gram calories (1000 grams equals 2.2 pounds, and 100—15 or 85° is the rise in temperature). Then dividing 2,000,000,000 by 3,863,000 we have 516.7. So one gram of radium emanation will, by decaying, give off enough heat to run such a boiler 516.7 hours continuously, evaporating 51,670 pounds of water. (See Fig. 1.)

This evolution of heat is really enormous compared with that emitted by any known chemical reaction. And there is every reason to believe that the total evolution of energy from any type of radio-active matter during transformation is of similar proportions to that of the radium emanation. The atoms of matter must consequently be regarded as containing enormous stores of energy, which are released by the disintegration of the atom. Investigations along the lines of the electronic theory of atomic structure bear out this view.*

Production of Helium

In 1902 Rutherford and Soddy suggested that the helium which is invariably found accompanying radio-active minerals was derived from the breaking up of the radio-active matter. A year later Ramsay and Soddy, in their famous researches which recalled to us thru newspaper comment the old alchemy, definitely showed that helium, a gas we consider as an individual element, was produced by radium and also by its emanation. The presence of helium in the atmosphere of the sun is one of the arguments for radio-active matter in the body of the sun itself. It seemed very probable, that from its observed mass, the alpha particle was an atom of helium. This was proven by the work of Rutherford and Geiger who showed the alpha particle to be an atom of helium, carrying two unit charges of electricity. Hence, a form of transmutation of matter according to our general theories of chemistry has really taken place.

In order to prove this definitely, it was necessary to show that the alpha particles themselves give rise to helium. Rutherford and Rayes did this by allowing the alpha rays from a large amount of emanation to pass thru the very thin glass walls of the containing tube. The collected particles gave the spectrum of helium, proving them to be indubitably helium atoms. (Fig. 2.)

Hence, all radio-active matter expelling alpha particles gives rise to helium. The rate of production of helium as calculated by Rutherford and Geiger, who counted the particles and measured their charge, should be 158 cubic millimeters per year. Think of working with a quantity so small! A close agreement is shown by the observations of Boltwood and Rutherford, who found the production to be 163 cubic millimeters per year.

Products of Radium

The successive transformations of radium were shown in the table in the last article (part III) of this series. When a wire charged negatively has been exposed for some time to radium emanation it becomes coated with a thin film of radium A, B, and C. About twenty minutes after the removal of the wire from the emanation, radium A has practically disappeared and the rays arise entirely from radium C. This has proven of great value in measurements, as radium C is a source of an intense homogeneous alpha radiation. The wire, however, still shows a residual activity, very

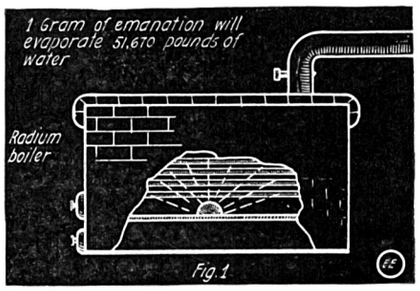


Fig. 1.—A Theoretical Radium Boiler. One Gram of Radium Emanation Will Evaporate 51,670 Pounds of Water, Before It Becomes Exhausted.

small and reaching a maximum in about three years. The slow change, of course, consists in the successive transformations in the series.

Radium D is rayless, and of a calculated period of 17 years. It was at first thought that radium E was complex, but no special evidence has been observed. Radium F is identical with polonium, the first active material separated by Mme. Curie. Similarly, radium D is the source of activity in "Radio-lead."

It is interesting to note the valuable results acquired from the observation of the extremely minute residual deposits from emanation.

Radium Emanation

The radium emanation has been purified by condensing it in liquid air, and then pumping off the residual gases. In a pure state the emanation is, weight for weight, 100,000 times as active as pure radium. Pure emanation in a spectrum tube gives characteristic bright lines. The electrical discharge in the gas (Geissler tube action) is of a bluish color, continued sparking driving the emanation into the tube walls and electrodes. Even with the minute quantities obtainable, the boiling point has been determined as 71° C. When first condensed, liquid emanation is colorless, at lower temperatures it freezes, while at the temperature of liquid air it has a bright rose-colored glow. The density of liquid emanation is about 5.5.

The emanation has definite chemical properties, and belongs to the group of monatomic inert gases, with argon, helium. etc. It is somewhat soluble in water, and readily absorbed by charcoal.

A large amount of work has been done in measuring the amount of thorium and radium emanation in the atmosphere, and in determining the quantity of radium and thorium in the earth's surface. Important theories regarding atmospheric electricity (the *aurora borealis,* etc.) and bearing on geology are based on this work.

Origin of Radium

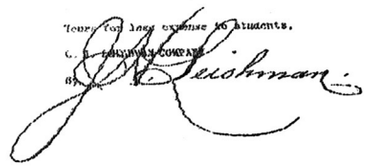
Radium is separated from the two uranium minerals, pitchblende and carnotite, the former coming from Austria, and the

(*Continued on page* 572)

* A few years ago, H. G. Wells, in a story appearing in *The Century Magasine,* used this energy as a weapon in the world war which he predicted. The story is really fascinating.

How I Telegraph Pictures

By



THE ELECTRICAL EXPERIMENTER has asked me to explain to its readers my system for the transmission of pictures by electricity —i.e., *Telegraphing pictures.* The actual workings of the instruments have never before been explained in detail to the readers of any periodical.

The idea of telegraphing pictures is not new; in fact, a scheme for accomplishing this was suggested fully seventy years ago. Of recent years, most experimenters that have entered this field have made use of the peculiar property of *selenium* for changing its electrical resistance when exposed to light. My system is far less complicated and expensive than those using selenium, and it is possible by its use to receive a very clear and distinct picture at almost twice the speed heretofore obtainable. It is needless to say that I make use of principles entirely different from those upon which other machines are based. This is due to the fact that I entered this field entirely ignorant of any other single wire system, my entire attention having previously been given to certain mathematical instruments.

Photograph of President Wilson As Reproduced At Distant End of Telegraph Circuit By Mr. Leishman's Recently Perfected Apparatus.

In order to make this discussion within the understanding of all, I shall avoid all technical language and make the explanation as simple as possible. Let it first be understood that the telegraphing of pictures is not *television;* it does not make it possible to *see* the person to whom you are telephoning, as that would necessitate the transmission of moving pictures, or about seventeen pictures per second. At the present time, such a thing is impossible for both electrical and mechanical reasons. It *is* possible, however, to send and receive *one* picture in a very few minutes. Some people ask what would happen should the picture collide with a building. This, as readers of THE ELECTRICAL EXPERIMENTER probably know, cannot happen because the actual picture being transmitted remains at the sending machine, a reproduction being effected at the receiving end by the building up of minute portions, one at a time, until the entire picture is received.

The telegraphing of pictures therefore resolves itself into the following distinct elements: A means for gradually covering the entire surface of the picture by some device capable of translating the light and the shade of the picture into pulsations or variations of an electrical current; and a means for successively recording these pulsations or variations in the form of what appears to be graduations of light and shade.

How I accomplish these things can best be shown by first explaining how the tiny parts of the picture are successively transmitted and recorded. Obviously, this can best be done by an arrangement similar to a cylinder phonograph or dictating machine, both the sending and receiving instruments using this mechanism. The carriage that is sending or receiving, gradually progresses from one end of the cylinder to the other on a spiral or screw, and the picture itself rotates on the cylinder. This makes it possible for all parts of the picture to be covered in the same succession at both ends of the line. The cylinders must of course revolve in exact *synchronism* to prevent distortion, but for the sake of clearness this will be explained later.

The next problem is that of causing light and shade to affect the passage of an electrical current. This, of course, properly constitutes the sending device. As previously stated, some systems vary an electrical current by causing the light and shade of the picture to act upon a portion of selenium thru which the current passes. This is a very direct way of solving the problem, because there must be an "eye" that recognizes light and shade and that will vary an electrical current accordingly. It is possible, however, to accomplish this in an easier, cheaper and less complicated way. I perceived immediately that a picture composed all of black and white could be made to make and break a current by forming the black or white on an insulating material upon a metal plate and causing a current to pass from the plate to a tracing needle, so that the insulating parts would break the said current.

Mr. Leishman and His Machine For Telegraphing Pictures, Photos, Script, Etc., Over Telegraph Or Telephone Lines.

Another Sample of the Work Which the Leishman Machine Will Reproduce In a Few Minutes Over Existing Telegraph Circuits.

This idea then had to be elaborated upon to permit the transmission of a *half-tone.* All newspaper half-tones, and the great majority of those in magazines, are really composed entirely of black or white; that is, any given point is either the one or the other. Examine one of these pictures closely and you will find it to be composed entirely of little black dots, the shaded effect being an optical illusion due to the size of the dots. There are a fixt number of these dots to the linear inch, varying in newspaper work from forty to eighty. If the half-tone is what is known as sixty screen, then there are sixty dots to the linear inch; and the light and shade, as before stated, is produced by the size of the dots, the lighter portions having *small dots* and the larger portions *large dots* that sometimes join and produce a mass of black.

These dots may of course be formed of insulation and will break the current for a period of time proportionate to their size. This is the general idea of transmitting a half-tone.

Before explaining the exact operation of my picture transmitting device, it may be well to explain the method of preparing the half-tone in order to obtain the insulating dots. For this, I follow up to a certain point the regular process of photo-engraving. The picture to be transmitted is first photographed thru a screen, the function of which is to break up the picture into dots whose sizes vary as previously explained. A copper or zinc plate is then

coated with a solution of glue, bichromat of ammonia and water. This is placed in contact with the developed negative and is exposed to strong light. The bichromat of ammonia is the element acted upon. When the plate is washed, the part that has not received the light washes away, leaving the rest fixt to the plate. Upon heating, the gelatine picture turns to a chocolate color. The regular photo-engraving process goes still further, but this is all that is necessary in the preparation of a picture for transmission, as the dark portions form a very thin and highly satisfactory insulation.

The plate is then rolled into a thin cylinder and slipt over the cylinder of the machine. The transmitting carriage consists of an arm into the end of which may be screwed an ordinary phonograph needle, which is held against the plate by a spring. A current passes between the needle and the cylinder excepting when an insulating dot passes beneath the needle. As previously explained, the mechanism permits the needle to cover every part of the picture. In this manner a picture is transmitted.

At the receiving end of the line, the current from the transmitting machine passes thru the coils of the electro-magnets on the receiving carriage. These attract a very light armature, causing the saffire or diamond in the forward end to press against the cylinder. This pressure does the recording. The stylus may be made to cut a stencil; scratch camphor smoke from white enameled paper; scrape white wax from dark paper; or press upon a carbon sheet, thereby recording and reproducing the picture upon ordinary paper. *The pictures illustrating this article were received by the latter method.* In this manner, all the dots on the sending machine are accurately reproduced on the paper at the receiving end. These dots, since they vary in size according to the light and shade of the picture, form an excellent half-tone likeness of the original object.

Some of the readers of this article may wonder why the recording is not done by making a pen out of the receiving stylus and causing it to write upon ordinary paper. The reason lies in the fact that a pen and ink arrangement is necessarily more complex than the system above explained; it gets out of order easier, and when recording at the rate of *two hundred and fifty-one dots per second,* which is the speed at which a picture is recorded, it is not as efficient as the methods described.

The construction of the receiving arm should be very light to overcome friction, gravity and inertia. It should also be sufficiently stiff to avoid vibration. Friction can be very largely eliminated by using jeweled bearings. The electro-magnets used for actuating this arm may be polarized so that the current has merely to change the degree of magnetization. It is possible to make a receiving carriage that will respond to feebler impulses, but this is not as desirable as speed.

By connecting a rheostat in series with the receiving carriage, the current can be adjusted to make the receiving arm record as efficiently as possible, and pictures can be made lighter or darker at will.

There is another detail worth mentioning in regard to the sending apparatus. Unless some means is taken to prevent it, a spark forms at the break of the current, which of course takes place as an insulating dot passes under the needle. This can be prevented in three ways. One terminal of a condenser may be connected to the cylinder,

This Reproduction of a Photograph By the Leishman Process Shows Particularly Well the Way In Which Features Are Brought Out. Hold Picture at Arm's Length to Obtain Best Effect.

and the other to the needle; or enough resistance may be introduced into the line to absorb the energy; or resistance may be shunted across the gap so that the current at break merely becomes too weak for the electro-magnets at the receiving machine to attract the recording arm. The latter plan has the advantage of reducing what may be called the inertia of the line, due to its capacity and inductance. This, however, is of little consequence excepting in long distance work.

So far as the use of this system with wires is concerned, there remains to be discust only the *synchronizing* of the sending and receiving cylinders. It sometimes happens that power is furnished from the same generator at fairly distant points. In this instance, synchronism is merely a matter of using synchronous induction motors. But in the great majority of cases, no such convenience may be resorted to. It is then best to use direct current motors operated by storage batteries with a sliding contact rheostat in the circuit.

The operator of the receiving instrument watches the recording of the picture; and, if the machines are not in perfect synchronism, he is warned by a deviation of the straight lines formed by the picture's upper and lower borders. If the line turns in one direction, his motor is going too slow, so he cuts out some of the resistance. An opposite deviation warns him to move the handle of the rheostat the other way. When storage batteries are used, the current is steady and very little adjusting of the rheostat is required.

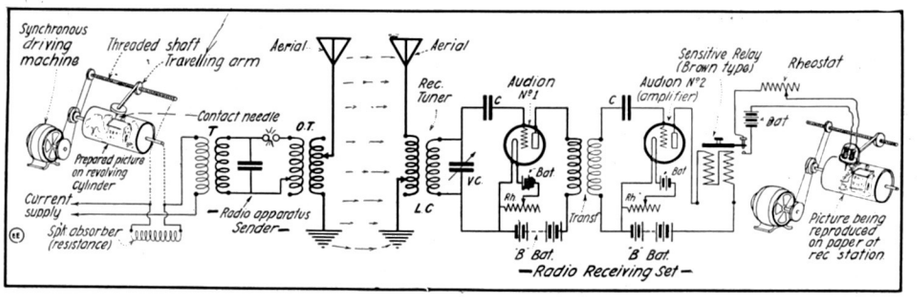
Automatic synchronization is of course desirable. One means of doing this, which greatly interferes with speed, very much resembles the method used by the Western Union Telegraph Company for hourly correcting their "standard time" clocks. At each revolution of the sending cylinder a heavy current is sent to the receiving machine, magnetically correcting the cylinder by stopping it momentarily. Some such means for synchronizing is absolutely necessary where the recording is not visible; but where the recording can be seen, manual control, of the nature described, may be used, altho mechanical synchronizing is preferable. I have recently designed a machine for this purpose—one that is far ahead of the system described above, but at the present time, I do not wish to disclose the details. The system permits the cylinders to revolve continuously, and the receiving machine may be started and stopt from the transmitting end.

A good deal has been said regarding the operation of my system by *radio.* It will be obvious that the transmitting apparatus may be connected into the circuit instead of the wireless key, and the picture transmitted in the usual manner. At the receiving end, an Audion detector and amplifier make the signals sufficiently strong to operate a relay, and this throws in a local circuit to record the picture.

It may be of interest that I have recently applied for a patent on an entirely different method of transmitting photographs, this scheme permitting the cylinders to revolve at about ten revolutions per second. This particular apparatus makes use of the automatic control previously mentioned. On this system, gravity and inertia have no effect, and all friction is eliminated, excepting that caused by the turning of the cylinders.

At the beginning of this article it was stated that *tele-vision* is at present impossible for both mechanical and electrical reasons. These facts are interesting, and I wish to mention them for the benefit of all electrical experimenters. As before explained, the best moving pictures require *seventeen flashes a second.* For the sake of explanation, let us consider the transmission of one picture per second, and let the picture be one of the easiest to transmit—a portrait, for instance. The picture should be gone over from top to bottom by the electric "eye" in the neighborhood of four hundred times. This would necessitate

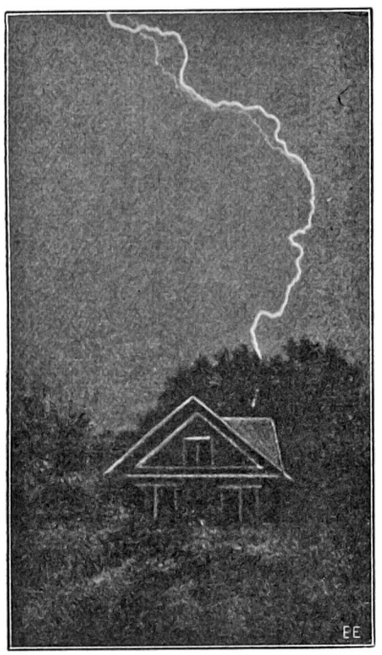
(*Continued on page* 572)



General Arrangement of Leishman Transmitting and Reproducing Apparatus for Telegraphing a Picture Via Wireless.

PHOTOGRAPHING LIGHTNING.

To many timid persons the fine art—for art it really is—of snap-shotting "lightning" is actually about the most dangerous job to



An Excellent Photograph of Ribbon Lightning Taken in Iowa the Past Summer. This Is What We Mean by "Odd Photos."

be found. But many amateurs and professionals have taken excellent photographs of lightning discharges and still live to tell the tale. For instance witness the accompanying photo taken last summer by the Rev. C. Lilie, of Iowa.

To take a good "lightning" photo is more often than not a matter of pure chance. Having loaded up the camera, the first thing to do is to open the shutter for a time exposure; as soon as the first flash appears close the shutter quickly. The job is done. Simply develop the plate in the usual manner. *Heat* or *flash* lightning will give peculiar results. The writer took several photos of *heat* lightning recently and the results are—an ordinary photograph of the surrounding landscape, just as if the sun had been shining. Combinations of *forked* and heat lightning often yield excellent pictures. Chain or forked lightning will produce a startling photo if the camera is swung from side to side while taking the picture.

ELECTRICITY AND GOLD FISHES.

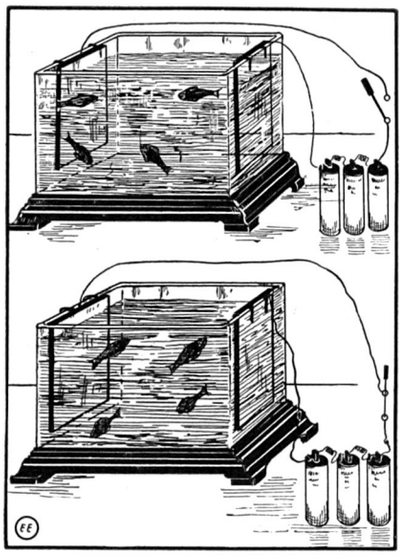
By H. Gernsback

Not so long ago, the writer, while watching some gold fishes at play in his aquarium had the idea of testing the fishes as to the effect electricity would have upon these highly sensitive animals. Accordingly two metal plates were sunk into the tank as shown in the illustration, and three batteries were connected to the two plates.

A curious thing at once happened. Using a current of three dry cells and upon closing the switch, all the fish immediately *grouped themselves parallel with the plates* and as long as the current was left on the fish remained in this position, refusing to swim or move in any other way but parallel to the plates.

The explanation of this phenomenon of course is that the current traveling from plate to plate, traverses the fishes' bodies, and as a fish is longer than it is wide, and as it is quite sensitive to the electrical current, it follows that inasmuch as the current probably proved disagreeable to the animal, it presented the shortest path to the current by placing itself parallel to the plates. It seems the fish did not cherish the idea of taking the full strength of the current thru the nose and mouth and thence thru the sensitive fins of the tail.

Another thing observed was, that the moment the switch was closed, there was a certain amount of excitement among the fish and if the closing and the opening of the switch was kept up, they would dart around in a most extraordinary manner, while thus under the influence of the current. As soon as the current was turned on and left on, however, the fish did not seem to be uncomfortable except that they only moved parallel with the plates as above mentioned. Another point observed was that while under the influence of the electrical current, the fish refused to come up and feed tho quite hungry, having gone without food for twenty-four hours. The instant the current was disconnected, the fish immediately would begin feeding, but did not seem to be quite so anxious as at other times. This would tend to show that the electrical current was not of immediate benefit to them, altho this can not be vouchsafed, the experiment having not extended over a sufficiently long period. At any rate, the fish did not seem to be harmed by the continuous application of the current, and after a few hours, seemed to be as lively as ever.



When Battery Current Was Connected to Two Metal Plates in a Gold Fish Aquarium, the Fish Immediately Grouped Themselves Parallel With the Plates, as Shown in Lower Cut.

Alternating current from a step-down toy transformer was also tried, but strange to say the fish were hardly affected by this form of current. This was rather unexpected, inasmuch as a rather convulsive action of the fish was thought to take place.

ELECTRICITY WASHES CLOTHES FOR U. S. TARS.

"Somewhere on the Atlantic," electricity is "taking in washing"—doing good work for Uncle Sam's Tars. On the supply, or "mother," ship an American electric laundry is operated, said to be the most complete and modern ever seen in that part of the world. The "boys" report that the work is perfect, and prices less than half those at home. One of the features of the ship's laundry is a complete soap factory.

NURSERY RHYMES TO DATE.

By JOHN T. DWYER.

Sing a song of sixpence,
Of "muckers" brave and bold,
Who turn the household upside down
In search of things untold—
Pins and needles; clocks and jars,
All articles of use
Are soon upon the missing list,
When a "mucker" is turned loose.

* * * * * * *

Little Jack Horner,
Sat in a corner
Eating a CURRENT pie.
He put in his thumb,
And then cried, "by gum!
This is SHOCKING indeed, Oh! my."

* * * * * * *

There is a fellow in our town
And he is wondrous wise,
The things he doesn't know about
Would fill a "skeeter's" eyes.

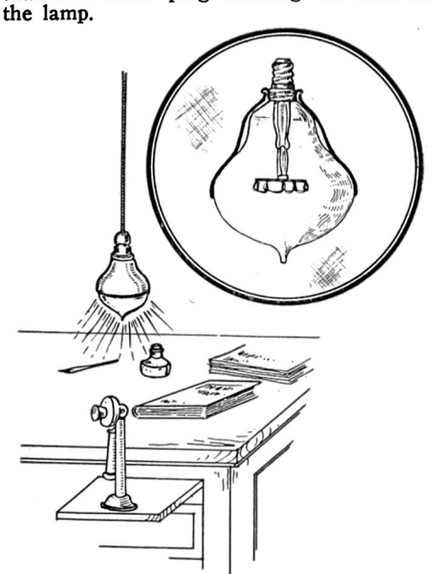
Now, it's got some folks a'guessing
How he could get such knowledge,
The more so, when they do consider
That he never went to college.

But to me the matter's simple—
And the reason can be seen;
He's merely one of many more
WHO READ THIS MAGAZINE.

NOVEL SHADE FOR INCANDESCENT LAMPS.

A simple design for an efficient incandescent lamp shade is described in a U. S. patent recently issued to Frederick R. Pope of London, England. This invention describes a type of shade which closely surrounds the upper portion of the lamp bulb, and which also serves as a reflector to direct and concentrate the light rays. It is claimed to be particularly efficient in locations where the supporting structure for the lamp is subject to a heavy vibration, as in factories and like places.

The arrangement, in brief, comprises an annular threaded collar, which screws on to a threaded sleeve on the lamp base proper. The collar is preferably U-shaped in cross-section, and forms a seat for a flange formed on the narrow end or neck of the shade. The shade may be of porcelain or any other material suitable for the purpose. It is very easy to replace the shade at any time, as the shade as well as the retaining collar both slip over the lamp base, as they are both of larger diameter than the screw plug forming the base of the lamp.



An Electric Shade for Incandescent Lamps That Screws Onto a Threaded Collar, so as to Be Supported by the Lamp Itself.

ELECTRICALLY HEATING THE FISH TANK.

The advantages to be obtained from the heat of electric energy are many and great, both as regards thermal efficiency as well as ease of application. Greater thermal efficiency is obtained in that electric energy is transformed into heat at 100% efficiency and is utilized at from 3½ to 4 times the efficiency of fuel combustion devices.

Here we have the Fish Tank electric heater. The customer has an aquarium in his residence containing fish brought from a warm climate. This necessitates warming the water which is accomplisht by installing a heater of the immersion type in the feed pipe supplying water to the tank. This heater unit is indicated by the arrow in the photograph.

Among other things, electrically made heat is clean, safe and sanitary. It can be used in any atmosphere and generated in any quantity or at any temperature desired. By its use the fire hazard is greatly reduced and the working conditions of labor vastly improved. It is susceptible of perfect and automatic control as regards localization, time and temperature to an extent not yet attained with any other method, and exact conditions can be duplicated at will.

The heating unit is invariably small, compact and substantially built, which allows of greater flexibility in application than with any other heating device. When applied to various industries or processes of those industries each unit has its own specific advantage.

In heating of liquids, melting of metal in pots and hotplate work, the units are so shaped and embedded in the apparatus used and of such thermal characteristics as to accomplish the work with the least possible expenditure of time and energy and at highest efficiency.

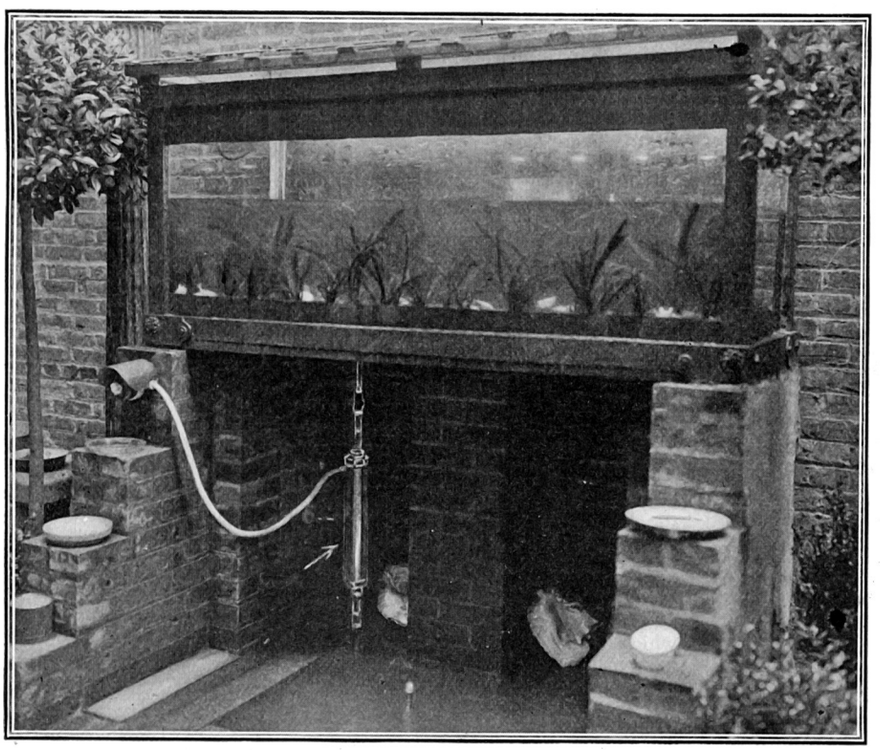


Photo Courtesy Society for Electrical Development

This Picture Shows How an Electrical Heater (See Arrow) Was Adapted to Warm the Water in a Fish Tank Containing Tropical Members of the Finny Tribe.

"GIVE SOMETHING ELECTRICAL THIS CHRISTMAS."

Higher wages, consequently more money to spend; a newly created desire for conveniences and the demand for thrift are all working to make this year the banner Christmas year for the electrical industry.

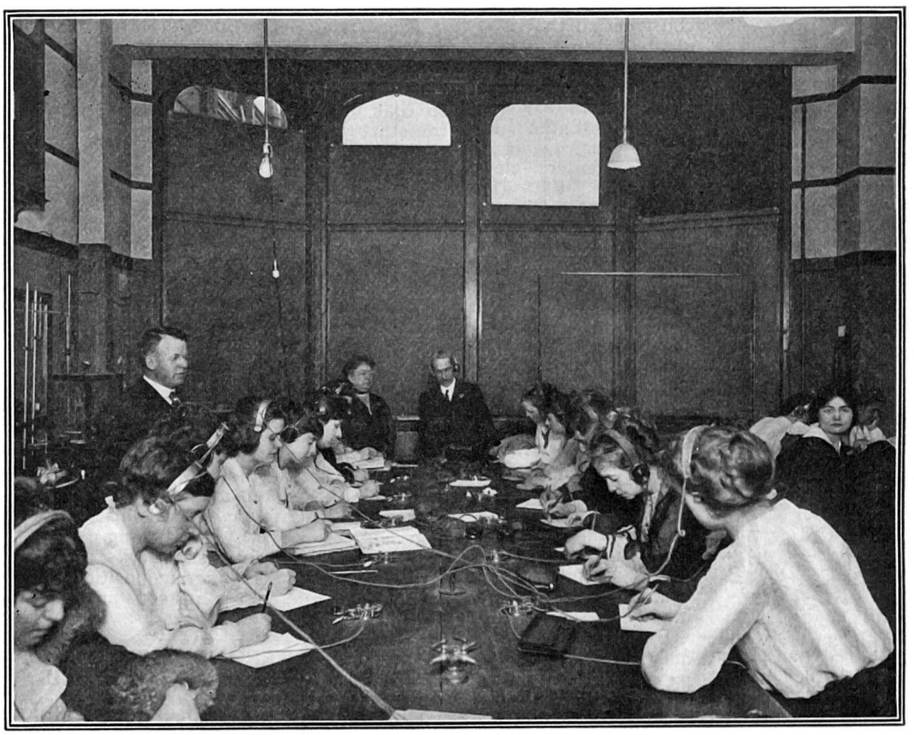
The strong appeal of practical electrical gifts for the home will bring scores of people into the electrical shops where formerly they have been buying toys and knickknacks, and realizing the trend of opinion, *The Society for Electrical Development* has planned a big nation-wide Christmas Gift Campaign. The broadside announcing this Campaign has been mailed to 20,000 persons. The features of "America's Electrical Christmas" are outlined and information given regarding the display publicity material available to help the electrical industry get its share of the $200,000,000 annually spent for holiday presents.

Remembering the success of "Electrical Prosperity Week, 1915", "America's Electical Week, 1916", "Wire Your Home Time", central stations, manufacturers, jobbers and contractor-dealers will realize upon this opportunity. The electrical industry never has gotten its share of the big money spent in Christmas gifts. This is the first concerted effort in this direction, and the time is opportune for an immense business.

The sales helps being prepared for the campaign with the slogan "Give Something *Electrical* This Christmas" include a special holiday edition of the Monthly Sales Service of the Society. Timely advertising suggestions will be given and special window displays will be shown.

WOMEN MAKE GOOD RADIO OPERATORS.

The accompanying illustration shows a number of women being taught the rudiments of Radio-telegraphy at one of the leading colleges in New York City.



Women Radio Students Are Daily Increasing In All Parts of the Country. This Group Was Snapt Hard at Work In a New York City College.

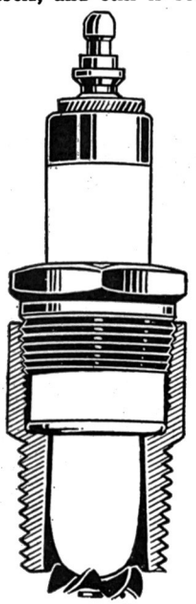
The photograph is reproduced thru the courtesy of the *National League for Women's Service.* These women who take up the study of wireless will find plenty to do in helping their country to win the war.

CORRECTION NOTICE.

We wish to correct a statement made in the article entitled "Historic Electric Apparatus," which appeared in the November issue, concerning the history of "Wireless." The first trans-Atlantic radio signal (the letter "S") was recived at St. Johns, Newfoundland, instead of Cape Cod, Mass.

FAN FLAME SPARK PLUG THE LATEST.

Any plug will spark when it's new and clean. But no ordinary spark plug actually adds power to the motor, actually cleans itself, and still is so simple and sturdy in construction that it is unaffected by the most severe conditions of heat, speed and high compression, say the sponsors of the Fan Flame plug.



This Spark Plug Has a Fan Electrode That Revolves.

The center electrode of the fan flame plug terminates in a miniature rotary fan which is heat proof because it is 98% pure nickel. This fan is constantly rotated at high speed by the successive compressions and explosions.

The whirling fan produces a circle of flame instead of a mere spark. It literally throws a shower of fire in every direction, igniting the comprest gas several times as rapidly as an ordinary spark can do it.

By careful tests the makers claim to have proved that the nickel fan constantly rotates in the cylinder when the engine is in operation.

The effect of the rapidly whirling blades is to throw off all oil and soot by centrifugal force so that the sparking points are always clean, and the accumulation of soot on the rest of the plug is also retarded.

A 40,000 AMPERE SWITCH.

The accompanying illustration shows a remarkable end-cell storage battery switch which has a steady capacity of 10,000 amperes or a momentary load of 40,000 amperes for six minutes. It is used for regulating the voltage of storage batteries in large central stations.

The construction of the 10,000 ampere cell switches is shown clearly. Each switch has two horizontal rails of rectangular section and two rows of massive contact points, arranged alternately at the corners of an imaginary square, the four traveling brushes occupying the sides of the square. The brushes are mounted on and suitably insulated from a traveling carriage, driven by the horizontal driving screw. Two 10,000 ampere cell switches are shown in the illustration herewith.

The driving screw in each case runs the entire length of the switch, and is geared to a motor at one end. This motor is provided with semi-automatic distant control, so that the switchboard operator can start the brush in either direction from any point and bring it into full contact with any other point, but cannot stop it between two adjacent points.

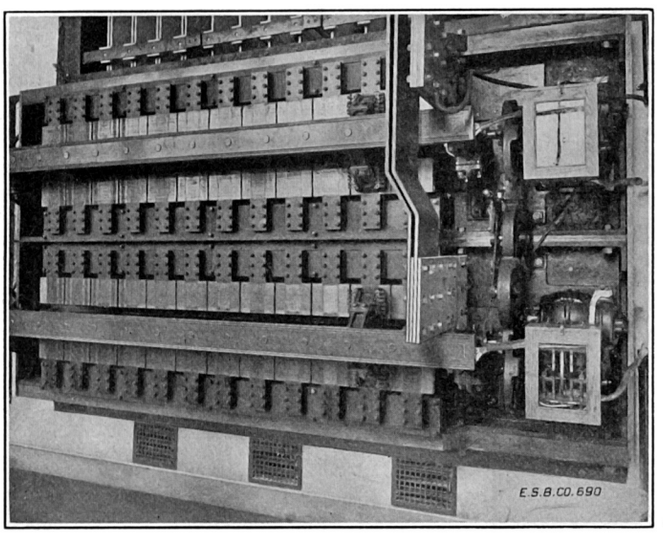
Two electro-magnets, of the plunger type, located adjacent to the motor and excited selectively by the control circuit from the switchboard, serve to operate contact switches to connect the motor armature for either direction of travel, respectively. As soon as either plunger starts upward it breaks the exciting circuit of the other magnet, thus preventing any possible conflict between the two.

As soon as the motor starts, a cam wheel so geared to the motor as to make one complete revolution while the brush is traveling between two adjacent points, locks the active magnet plunger in position, thus maintaining the motor in constant action between switch points.

HEATING PERSONS INSTEAD OF ROOM IN WESTERN RESTAURANT.

In following up the policy of "localizing heat," a leading electric heating concern recently secured a contract covering the installation of 30 electric heaters in the Tuberculosis Sanitarium of Independent Order of Foresters in Lopez Canyon, a short distance from Los Angeles.

These heaters will be installed, without the stands, on the under side of the table in the dining-room, radiating the heat downward to strike the floor and be radiated up, by this means keeping the bodies of those at the dining table warm, rather than attempting to heat all the air in the room. In other words, they heat the *individual* instead of heating the room. Inasmuch as the diners will only be in the room 20 minutes, or half an hour during meals three times a day, it seemed unnecessary to attempt to heat the entire room, accommodating over 100 people, when it would only be occupied this short period of time.



Rear View of the Largest Storage-Battery End-Cell Switch Ever Built. It Has a Continuous Carrying Capacity of 10,000 Amperes and a Momentary Capacity of 40,000 Amperes.

COMBINED FLASHLIGHT AND LENS FOR DIAGNOSTIC PURPOSES.

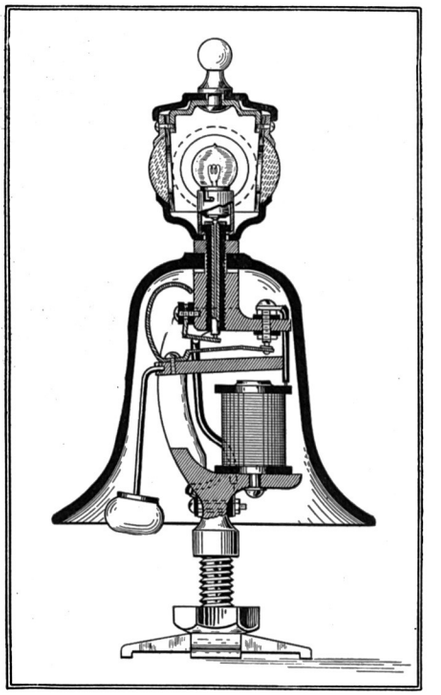
The present invention shown in the accompanying illustration is an ingenious arrangement combining a special form of pocket flashlight with an adjustable lens holder on the side of the battery case, and also means for attaching several forms of diagnostic instruments, such as a tongue depressor, which is here shown in actual use.

Several advantages are claimed for this particular form of flashlight diagnostic instrument; for one thing, no direct rays from the incandescent lamp are cast into the eyes of the physician, and more freedom of the hands is obtained by its use as becomes readily apparent, owing to the fact that three separate and distinct instruments are combined in one. A push-button switch is provided to open and close the lamp-circuit as desired. This idea has been patented by Hermann Weder, Sr., and Charles H. Wolff of Philadelphia, Pa.

A Recent Invention Comprises a Diagnostic Lamp, Lens, and Tongue Depressor All in One Instrument.

UNIQUE COMBINATION SIGNALING LAMP AND BELL.

In many instances, the orthodox form of electric signal or alarm is not desirable, and with these objects in mind, Mr. Christian Reinker, an Ohio man, has devised and patented the unique combination signal lamp and bell shown in the illustration herewith. Current is supplied to the device from a battery or other source of current thru two binding posts carried on the central stem at the base of the bell, and when the circuit is closed, the bell vibrates, while the lamp remains lighted constantly, as long as the switch remains closed. The design of the signaling device is unusually artistic, the lamp being enclosed in an ornamental chamber which is provided with one or more white or colored lenses cut in the form of jewels.



Unique Electric Signaling Device for Use on Autos, etc. Pushing a Button Lights the Lamp and Rings the Bell.

OPERATING THE COFFEE CUTTER BY ELECTRIC MOTOR.

By means of the cutter shown herewith steel-cut coffee can be furnished by the grocer in bulk with convenience and at a profit. It is built along entirely different lines from any of the mills on the market, and has been evolved to meet the insistent demand for machines that would cut, not grind, coffee.

The coffee cutter cuts the coffee uniformly and evenly. Granulating and pulverizing are done on the same burrs, giving a sandlike grain especially adapted to all kinds of percolators or drip pots now in such wide use. There are two sets of burrs, one of which revolves. The other set is stationary. The burrs are especially designed with diamond-shaped teeth. They

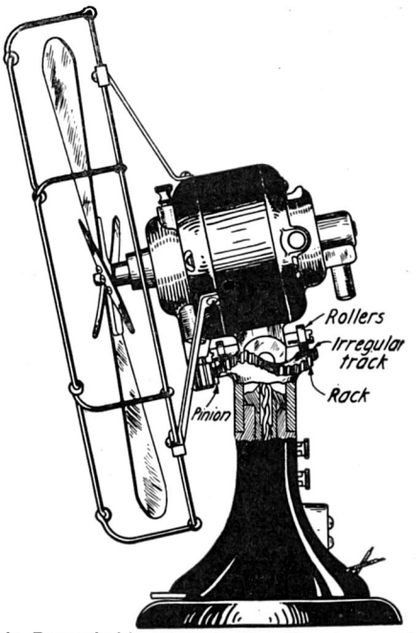
No Up-To-Date Grocery Store Is Complete Without an Electric Coffee Cutter.

are self-sharpening and self-aligning, having special ball bearings which take out all play. Thus the burrs cannot "wobble" and produce uneven granulation.

These machines are operated by totally enclosed, low-speed electric motors designed for heavy duty and without complicated mechanism to need adjustment. Due to the fact that a low-speed motor is employed, no gears are necessary. The motors are equipt with radial and thrust ball bearings, which reduce friction to a minimum and prevent wobbling of parts. They are silent and true running. The only parts needing lubrication are the ball bearings, and these need only be oiled about once a year. Thus there is no oil to accumulate in the burr case, none to get into the coffee, and all the nuisance of oiling is removed.

THIS FAN THROWS BREEZE "UP AND DOWN" AS WELL AS SIDEWISE.

The past few years have witnesst so many novel introductions in "Fanland" that



This Remarkable Electric Fan Revolves and Throws a Breeze Up and Down as Well as Sidewise.

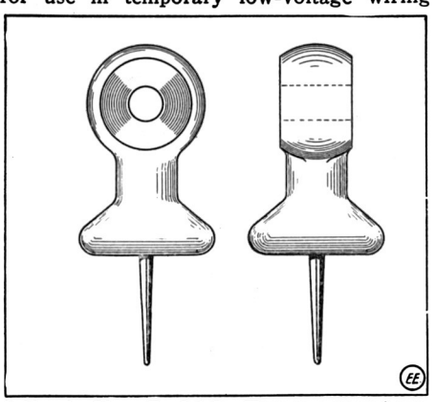
it would seem that about every imaginable form of electric fan had been perfected or thought of, but we have to salute Gustaf Olson of Chicago, Ill., for his very ingenious electric fan gear.

One of the most interesting points which had to be worked out in this idea was the shape of the gear teeth on the stationary rack, and also those of the pinion which meshes with this rack, as becomes clear from the accompanying illustration. The small driving pinion which rotates the fan-motor body proper, by means of this rack, is secured to a vertical shaft geared inside the motor casing to the armature shaft, so as to provide a positive drive for the rotational function.

Current is supplied to the rotating fan motor thru a set of slip rings and brushes mounted in the base. Thus, this fan will not only throw a breeze in every part of the room at a certain level, but will throw the breeze toward the floor and also toward the ceiling periodically or about four times in every revolution of the fan motor, which may be adjusted to occupy about one fifth of a minute.

GLASS EYELETS FOR TEMPORARY WIRING.

Glass push pins provided with an eyelet for use in temporary low-voltage wiring

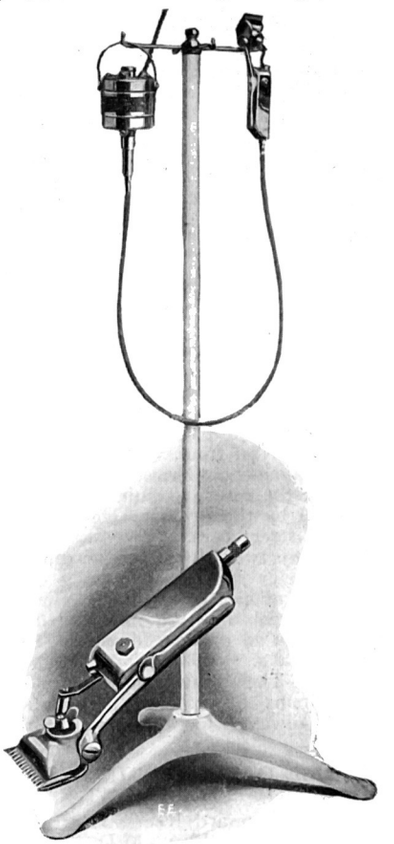


A Handy Glass Eyelet for Temporary or Low-Voltage Wiring.

are being made now. The pins are easily attached to woodwork or walls, and it is pointed out by the maker that they are particularly useful for amateur battery work where small wires are to be run about the house. They should prove particularly efficient in wiring up sensitive electrical apparatus such as galvanometers, radio receiving apparatus, etc., where a slight leak, such as thru wood, means a big difference in the efficiency of the instrument.

NEXT! WILL YOU HAVE AN ELECTRIC HAIR-CUT?

Barbering is one of the very old and universal trades. For years past there has been practically no advance or change in the general method employed of using shears, razor or clipper. It is true that the modern clipper with its improvements is a device which is of comparatively recent development, but aside from that the methods of the barber are the same as they were hundreds of years ago, so we



Good Morning! Have You Met the Electric Barber? Here's the Latest Tonsorial Device—A Motor-Driven Hair-Clipper.

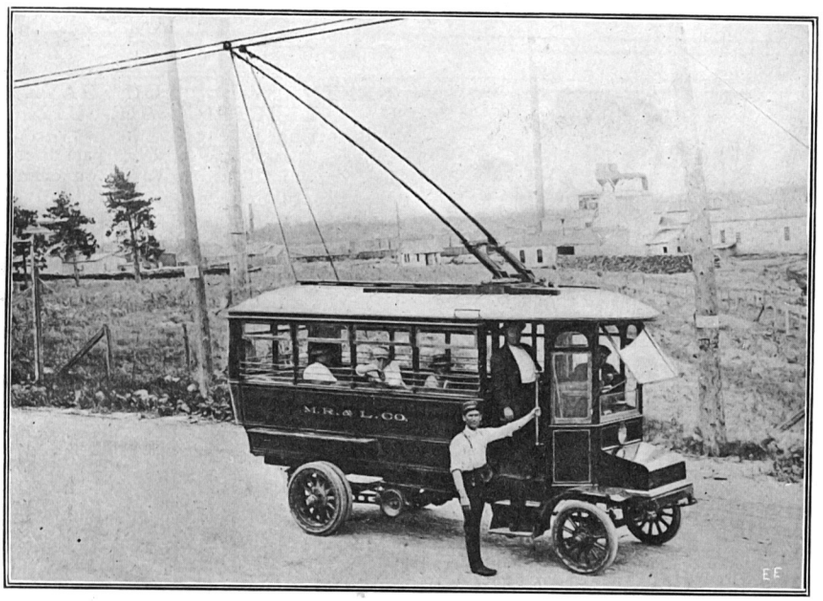
had begun to believe that it was only styles in trimming the hair or beard which change. But electricity can improve almost any unelectrified method or device. The electric hair cutter here illustrated is rapidly becoming popular, many Chicago barbers speaking very highly of it.

As will be seen from the illustration, the machine consists principally of a light iron standard with cross arms at the top supporting the small electric motor, which is connected to the clipper by means of a flexible shaft three or four feet long. This shaft enters a translating device in which the revolving motion is changed to a horizontal motion for the handles of the clipper. This is necessary in order to cause the shearing edges of the moving clipper blade to pass back and forth over the other in the usual manner.

A TRACKLESS TROLLEY SYSTEM.

By L. Schoolcraft.

In Massachusetts there are now several lines of trackless trolleys. These vehicles resemble automobiles more than they do street cars, but their motive power is electric and the current is obtained from overhead trolley wires.



Massachusetts Now Boasts a Trackless Trolley. The Current Is Taken from Two Wires Thru the Double Pole Arrangement Shown. The Vehicles May Pass One Another on the Road Without Trouble.

It will be noticed in the illustration that there are two trolley poles on this car as well as two over-head wires, whereas in the ordinary street car there is but one. This is due to the fact that these cars do not run on steel tracks but on an ordinary road or pavement. The second trolley wire being for the return circuit. The cars are controlled by the ordinary controller as is found in street cars.

There are two advantages of this system of trolley—

First—The car may pass around other vehicles which may be in front of it or passing it in an opposite direction, thus reducing delays.

Second—The elimination of one of the largest items of expense in constructing electric railways which is the track or foundation.

THE USE OF X-RAYS IN DISEASES OF THE CHEST.

By Dr. Leonard Keene Hirshberg, A.B., M.A., M.D.

(Johns Hopkins University.)

When you look thru the greenish glass used as a screen, when the X-rays are focused on anyone's torso, you see an old time bird-cage or wire hoop-skirt with the ribs as circular wires, with shadowy, fugitive, fleeting phantoms of birds within the cage. An X-ray photograph imprisons this picture.

The X-rays, with the ribs as precise guiding posts, allows us to make an exact and minute examination of the topography hidden from the unaided human senses. A man without senses is a mental wreck. A doctor with all his senses is a most incomplete creature. He must call to the aid of his best endowments, those instruments of precision, which reach out to hidden things undreamt of in his best senses, much less his philosophy. The X-rays is one of many such assistants.

The X-rays can sometimes tell you to the fraction of an inch, the exact spot in the lungs or in the pleural cavity, just where a sore is situated. If the child has swallowed a pin or a penny, it will be nicely revealed.

There are forsooth failures with it: not every use of the X-rays is successful in itself. Tuberculosis may be present and escape discovery, if the other facts found in a physical examination are not also taken into consideration.

In maladies of the lungs, Dr. Howard Lilienthal of the surgical staff of Cornell Medical College, holds that no final judgment should be given unless the X-ray observations are also checked up with other soundings and investigations of the individual's state of health. He describes a little boy's condition in support of this.

The little patient in question was three and a half years old. He began to have spells of unproductive cough. There was no evidence of fever or weakness for the youngster played about between the paroxysms.

When this had gone on about ten days, he really became seriously ill. Fever appeared and the little fellow began to cough up mucus.

An examination with the stethoscope and fingers on the back of the chest, showed it to be a bit flat and dull in sound with increased voice production. It was decided that there must be some fluid or pus between the lung and chest wall. This is pleurisy—not the popular fallacy of a pain in the chest.

An X-ray picture was then taken of the chest on the side affected. The solid patch of dark in the negative suggested pneumonia, but from the stethoscope examination this was properly interpreted as pus-pleurisy or "empyema."

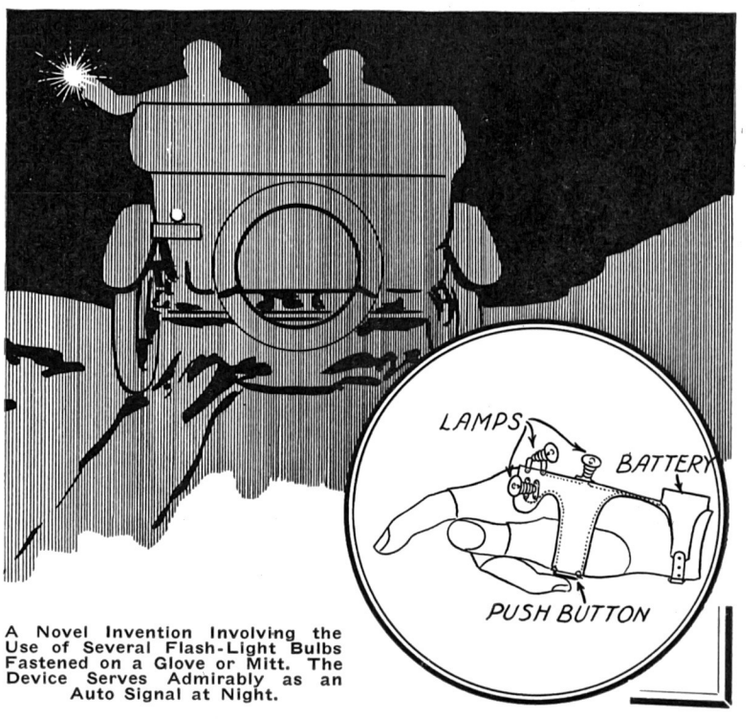
An anesthetic was then given and a tiny needle-tube was pushed into the pleural cavity much as a beer-keg is tapt, the matter and pus were drained away, and lo and behold a second X-ray photo showed a large watermelon seed in the child's windpipe.

This was removed and the youngster was soon well and happy. The two X-ray pictures alone would not have been enough to make a correct diagnosis. The stethoscope alone would not have done so. A wonderful doctor with all the fulness of sound senses could not have done so without the other aids.

UNIQUE BATTERY SIGNALING LAMP WHICH STRAPS ON HAND.

While the ordinary battery flashlight has proven its efficacy in many instances, an inventor, August Sundh, has devised and patented the flashlight signaling and illumination outfit here pictured. In his patent he states that the apparatus is intended and especially adapted for the use of persons working around machinery or in place where portable lights are used. Also it is pointed out that it will prove useful for automobiles and trainmen, such as for signaling purposes, and its use in this direction is illustrated in the accompanying view, where the autoist is shown giving a night signal that he is about to turn a corner.

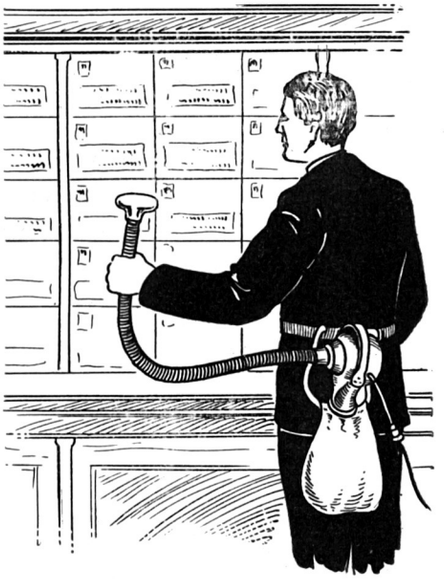
The device is quite simple and merely comprises a leather or other form resembling a glove, which straps on the hand and at the wrist. This glove contains a flap pocket to carry a small flashlight battery. Several miniature battery lamps are disposed in various positions at the back of the leather mitt as the illustration discloses, and the circuit between the battery and lamps is closed whenever desired by pressing on a small push-button switch secured on the inside of the mitt.



A Novel Invention Involving the Use of Several Flash-Light Bulbs Fastened on a Glove or Mitt. The Device Serves Admirably as an Auto Signal at Night.

CARRY THIS VACUUM CLEANER ON YOUR BELT.

We think vacuum cleaners have been perfected to the limit in this country, but here's an English type of portable electric "suction" cleaner, as they call it over there,



This Electric Vacuum Cleaner Straps to Your Belt. It Is Light in Weight and of Extreme Flexibility.

that will do real pretentious work, and weighs but 7½ pounds. It is really one of the most ingenious vacuum cleaners developed. A man can work right along with it without tiring and besides it is especially adapted to cleaning stock on shelves, books in libraries, et cetera.

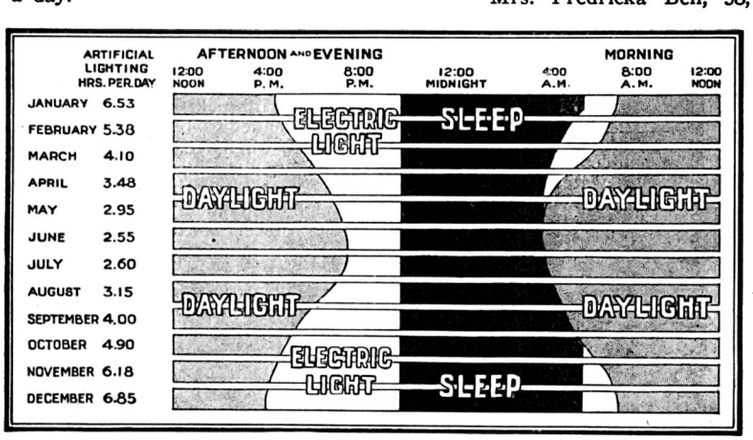
The belt type electric suction cleaner, by a turn of the switch and a guiding hand, sucks out the dust from fixtures, shelves, stock, stationery, machinery, etc., in a jiffy.

WHY YOUR WINTER ELECTRIC LIGHT BILLS ARE HIGHER.

The accompanying chart shows just why your electric light bills are higher in some months than others.

In winter you depend upon artificial lighting nearly *three times* as many hours in each 24 as in summer.

In June the average use of electric light, in a residence, is 2 hours and 35 minutes a day.



This Chart Shows Just Why Your Electric Light Bill Runs Higher In Winter Than In Summer. Daylight Is Shorter for One Reason.

In December the average use of electric light, in a residence, is 6 hours and 50 minutes a day.

This is perfectly natural. As the summer days lengthen, the "electric light hours" become longer, says the *Society for Electrical Development*. So on until January when the days grow longer and the "electric light hours" grow shorter.

There are other reasons, too, why your bills in fall and winter are larger than in the spring and summer—good reasons that show it is simply the result of the season's changes; your more extensive use of electric light, and not the fault of the electric light company at all.

When summer is over, vacations are over. Everybody is home again; more rooms are occupied; more light is needed.

Long evenings—late bedtimes. The outside cold keeps us indoors. The soft, cozy glow of electric light makes reading a pleasure. More people stay home on this account. The newspapers, magazines, study or a good book, music and games pass the evening all too quickly. It is bed-time before one knows it!

More entertaining is done—parties at home for the grownups and little folks. Sometimes the house fairly radiates with the good cheer of electric light.

RADIO-ACTIVE LUMINOUS COMPOUNDS AND THEIR DECAY.

At a recent meeting of the Royal Society, Mr. J. W. T. Walsh read a paper on this subject. The theory of destruction of "active centers" put forward by Rutherford to account for the decay of luminosity of radio-active luminous compounds leads to a simple exponential relation in the special case of a compound of constant activity. It has been found for radium zinc sulfid compounds that this relation expresses the observed results to a sufficient accuracy over short periods of less than 200 days, but that it fails to do so over longer periods, such as 500 days, the rate of decay of luminosity becoming gradually slower and slower, so that the brightness tends to a limiting value which is not zero. The present paper is an attempt to find a luminosity time relation which will allow of the prediction of the intimate behavior of compounds of varying composition

GRANDMA, RADIO EXPERT, VOLUNTEERS.

A grandmother has offered to conduct classes in wireless telegraphy in St. Paul. Mrs. Fredricka Bell, 58, of that city, learned to send and receive by wireless from her grandson, Harland Hall, now at the United States navy radio station, Duluth.

Before their station was dismantled she "listened in" and heard messages from all parts of the country.

If the government will grant permission for the erection of a wireless station in St. Paul, Mrs. Bell says she will teach all branches of wireless operating. If that is impossible, she probably will have classes at the Y. W. C. A. to teach women the continental code.

THERMOSTATIC REGULATOR CONTROLS RADIATORS.

One thermostat will control a number of radiators. The valve and thermostat are connected by electric wires conveniently placed; the operating current is so small that it is hardly perceptible and is obtained from the lighting circuit.

The opening or closing of this circuit operates the valve or valves connected to the radiators in the room. The thermostats are so arranged that a range of 30 degrees can be obtained.

Thermostat for Regulating Radiators.

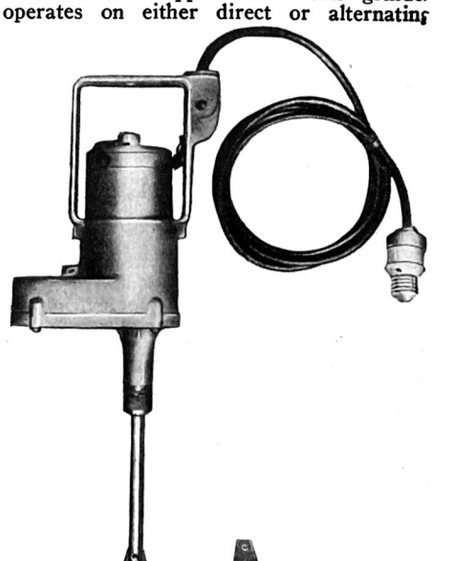
It may be necessary at times to shut steam off the radiators in order to make repairs or in case certain rooms are to be unoccupied. The makers provided for these emergencies by placing a valve stem in the top of each valve, which may be operated by a key which is furnished with each valve, to close the valve by hand.

In the thermostat is a small metal diafram capable of expanding and contracting. Within this diafram is sealed a small amount of a volatile liquid. The slightest variation of temperature either expands or contracts this diafram, expanding with rise of temperature and contracting with the fall of temperature. This diafram actuates a metal strip, thereby opening or closing the electric circuit as the case may be.

ELECTRIC VALVE GRINDER FOR AUTOISTS.

A valve grinder fitted with an electric motor and which may be connected to any handy lamp socket has been placed on the market by a Michigan manufacturer. This grinder develops speeds of 400 to 750 oscillations per minute. Between the mechanism of the grinder and the valve a flexible contact is provided for furnishing a light, medium or heavy pressure upon the valve.

The motor supplied with this grinder operates on either direct or alternating



A Motor-Driven Valve Grinder for Auto Engines.

current. A set of valves may be re-ground in an average time of thirty minutes.

ALLEN P. CHILD.

TELEGRAPH LINEMEN OF THE FAR NORTH.

The line gang of a telegraph company operating in temperate climes may think

Instead of Spurs These Telegraph Linemen of Alaska Wear Snow-Shoes. The Poles Are Tripods Which Rest on the Ice and Snow.

they are roughing it some, when the snow and chill winds begin to blow, but consider the hardships experienced by a lineman in such frigid countries as Alaska.

The accompanying photograph shows linegang employed in stringing the wires for the government railroad telegraph lines in Alaska. Instead of the old reliable "climbers," or spurs, each man is equipt with a pair of snow-shoes. In the lower right corner of the picture may be seen a string of porcelain insulators and a coil of wire.

Did you ever stop to think how the linemen place their poles in such localities, covered the year around possibly with snow and ice? "Dig a hole"—is your first answer. Well they don't use poles, not as we know them down here in the States. In the background of the present photo can be seen an Alaskan telegraph pole. It is really a tripod formed of three fir poles, nailed together and surmounted with one, or more insulators, depending upon the number of circuits in use.—*Photo courtesy Donald McNicol.*

RADIO FOR WOMEN AT UNIVERSITY OF CALIFORNIA

Wireless telegraphy for women is to be one of the University of California's courses and the new study has been added because of the request of the wife of an officer stationed at the Presidio. It is the first time such a course has been offered by the extension department.

The class will be held at the Polytechnic high school in San Francisco every Saturday beginning September 1. There are to be two sections, one in the morning and one in the afternoon. Professor A. L. Jordan, head of the department of science in the Polytechnic High School, will teach the course in the wireless laboratory of the school building.

CLEANING YOUR CLOTHES BY VACUUM.

Here is a device which will keep your clothes, and upholstered interiors of automobiles, et cetera, as fresh and clean as the day it left the respective work shops. By using the principles of brushing and suction this instrument thoroly cleans out the dust and collects it so that it will not settle again.

The brush does not revolve but contains an open center thru which a fan located in the metal container draws the dust. The dirt is loosened by the brush and the fan suction catches it and it is carried on into the dust bag. A special attachment is made for this device which permits the thoro cleaning of the buttons in the tufting of upholstery, which always hold, so tenaciously, against sweeping a great quantity of dirt.

This cleaner may be used as well for cleaning draperies, mattresses or upholstered furniture. The device will attach to any socket.—*Photo by Allen P. Child.*

Here's the Best Way to Dry-Clean Clothes—Use an Electric Vacuum Cleaner. This Method Spells Results with the Work Left Out.

The Submarine and Kindred Problems*

THE thousands of suggestions and plans presented to the Naval Consulting Board for assisting the Government in the present emergency indicate the patriotic fervor of the mass of our citizens.

The Board makes a careful examination of every proposal presented. To facilitate this work, by suggesting the elimination of impractical ideas, the Board calls to the attention of those who desire to assist it some of the popular misconceptions as to certain fundamental principles which are most frequently misunderstood by the layman.

A careful consideration of the following statements will greatly simplify the work of the Naval Consulting Board.

Electro-Magnets and Magnetism

The *Electro-magnet, the Magnetic-needle, Permanent Magnets and Magnetism* have been carefully studied for many years; and the laws governing their application may be found in any book on the subject.

Although these laws are generally known, and applied in a practical manner, in a multitude of devices in common use, even the man of wide experience will be astonished at the limited range of practical effect of electro-magnets of large size. For instance, the magnets used in our manufacturing plants for lifting heavy masses of iron or steel are designed to exercise maximum magnetic effect, and for operation require a very considerable amount of electrical energy; yet a magnet *which can lift twenty tons, when placed in contact* with an iron plate of that weight, will not lift a two-inch cube of iron or steel *if separated from it a distance of two feet.* Therefore proposed devices which depend on the attractive power of magnets for their operation in deflecting or arresting torpedoes, mines or submarines, must be governed by the simple laws of magnetism. A torpedo weighing approximately 2,500 pounds, and traveling at a speed of 25 to 45 miles an hour, will not be deflected to any practical degree by any known application of magnetism; and it is not believed that an enemy torpedo, mine or submarine will ever be found in a position to be interfered with effectively by any electro-magnetic means, however powerful.

Electrical Effects in General

There is a general misconception regarding the "electrification" of water and the atmosphere. There is no known method of "charging the sea with electricity," or "shooting a bomb of electricity," or of "charging the atmosphere with electrocuting current." Suggestions along these lines should show that the writer has made research in the laws governing the application of electrical energy and should contain sufficient proof of their feasibility to insure serious consideration.

On the other hand, applications of the transmission of electrical energy by means of alternating or pulsating currents—as used in wireless systems, for example—belong to a different class of electrical development. Inventive genius is rapidly improving apparatus of this type for the sending and receiving of signals and messages, and the possibility of valuable results in this field is unlimited.

Protection Against Submarine Attack

This subject, which is occupying the public mind as is no other, divides itself into a number of problems, the most important being the following:

(a) *Means of discovering* the approach of a hostile submarine and locating it so as to permit of prompt action for combating its attack.

(b) *Protection of cargo-carrying ships* by nets, guards and screens.

(c) *Protection thru decreasing the visibility of vessels.*

(d) *Methods of destroying or blinding* a hostile submarine.

Submarines, to operate most effectively, must approach within close range of the vessel which is intended to be torpedoed. The installation of offensive weapons on the merchant marine has increased the necessity for the utmost care being exercised by the submarine commander in remaining unseen by the officers on the vessel to be attacked.

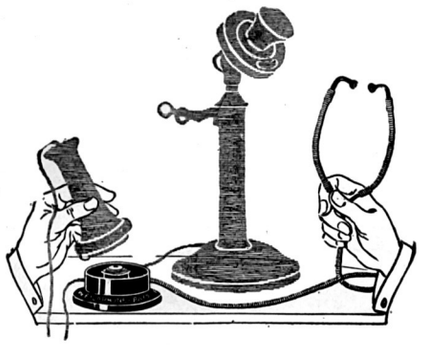
Reports from abroad indicate that in many cases submarines must have remained along certain lanes of travel for periods extending into weeks of waiting with the expectation of torpedoing certain vessels. Under certain favorable conditions, where the waters are less than 200 feet in depth, a submarine might lie at rest on the bottom, and if equipt with sensitive listening devices attempt to detect the approach of a vessel. As soon as this evidence was secured the submarine might come to the surface for a quick observation by means of the periscope and in this manner obtain the proper aim which would be required to register an effective hit.

(*Continued on page* 579)

*Publisht by Naval Consulting Board of the United States.

A TELEPHONE AMPLIFIER THAT LEAVES HANDS FREE.

The telephone as it stands today is practically a perfect instrument. There are times, however, when the hearing efficiency is far below normal. At such times you are forced to ask the person at the other



This Telephone Amplifier Is a Distinct Advance. It Has No Direct Connection with the Telephone. You Simply Place the Receiver on the Amplifier, Leaving Both Hands Free.

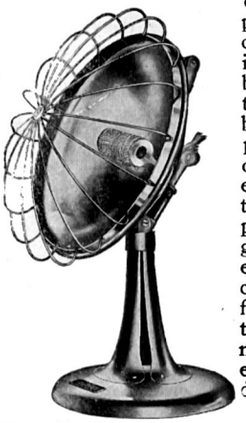
end of the line to speak louder, sometimes to shout. Even then you don't always hear clearly. You must ask him to repeat almost every word that is said.

The new telephone amplifier here pictured, greatly increases the hearing efficiency of the telephone, all harshness disappears and you hear the voice in its natural tones, its inventor claims. This is accomplisht by the accurate tuning of the sound chamber in the instrument. This sound chamber contains no mechanism to get out of order. Just as a sounding board behind the speaker increases the voice volume, so this new amplifier amplifies the telephone sound.

It often happens that while telephoning you wish to write down some note, consult a catalog or read a letter over the 'phone. At such times the busy man will welcome such a device.

NEW ELECTRIC HEATER.

A novel portable electric heater for home use is shown herewith. The outfit is substantially constructed of prest steel, on the principle of the portable lamp. A steel reflector 9½ in. in diameter is connected to the top of the pedestal by a hinged joint which is adjustable to numerous positions from horizontal to diagonal, upward. This reflector, which is of a special parabolic design, is heavily plated with a triple coat of highly polished copper. The back of the reflector is finished in black enamel. Wire protecting guards over the heating element are attached to a copper-plated rim. These guards may be easily removed for cleaning the reflector or changing the heating element, which is also easily and quickly detachable.



Portable Electric Heater.

The heating element consists of a composition core 1 in. (2.54 cm.) in diameter, around which is wound high-resistance wire. The wire is first wound into a small coil and then wound around the composition core, giving a large amount of resistance material in a small area. This coil will attain a temperature of about 1,200 deg.

A New Combined Stereoscopic and Fluoroscopic Table

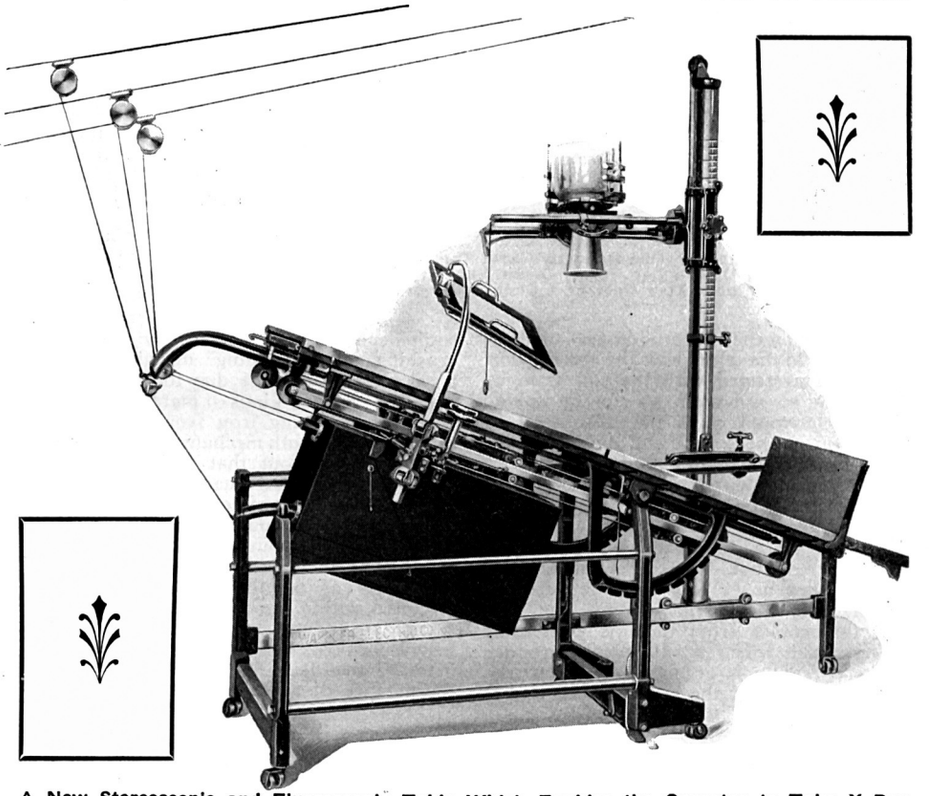
The new X-ray table here illustrated has recently been evolved by a New York concern. It combines a tube stand with table, which may be used for stereoscopic roentgenography and also for fluoroscopy, both in either the horizontal or vertical position. All moving parts are so poised and balanced that they may be smoothly manipulated by the operator without assistance.

Suspended beneath the table is a trochoscope tube box running on ball bearings and so designed as to afford ample protection from rays to the operator and patient. A special feature of this tube box is that it is lined with opaque rubber and covered outside with sheet lead. This affords the necessary protection from rays, while at the same time preventing condenser effect and resultant tube trouble. Another innovation is that of a vacuum reducing switch within the trochoscope tube box. By this means the operator may lower a gas tube without leaving the table. Provision is also made for the use of the Coolidge tube. The movement of the tube box gives a large field of vision and moves freely, no matter in what position the table top may be placed. Attached to a bracket, in conjunction with this tube box, is a curved support which suspends over the patient a fluorescent screen which can be twisted around in any direction required. This fluorescent screen is so constructed that it will accommodate a plate holder for the purpose of recording certain findings immediately by utilizing the rays from the tube beneath the table.

The stereoscopic plate changer within the table top is a feature which has evidently received considerable care. This works very smoothly and decisively in the horizontal position and yet works without jar when used for vertical stereoscopy. The tube stand, which is a part of the equipment, travels along the full length of the table. The tube bracket is well counterbalanced and is free to swing around, away from the table for use in conjunction with stretcher or other apparatus.

The insulation of the high tension current has been well designed and is such that tubes can be safely worked up to 9 inches back-up without fear of sparking or flashing across to the table.

All moving parts of the tube stand are carefully graduated so that records can be made of actual positions and it is thus possible to duplicate these conditions if necessary at any further time.



A New Stereoscopic and Fluoroscopic Table Which Enables the Operator to Take X-Ray Pictures in Either the Horizontal or Vertical Position. All Parts Are Balanced So as to Be Easily and Quickly Manipulated.

TO TREAT WOUNDED WITH ELECTRICITY.

Plans developed by Dr. Virgil C. Kinney, of Wellsville, N. Y., one of the best known electro-therapists in the country, for the formation, equipment and administration of an electro-therapeutic hospital unit to be establisht in France for American fighting men, were indorsed recently at the twenty-seventh annual convention of the American Electro-Therapeutic Association at Atlantic City.

"The remarkable results achieved by European belligerents thru physical treatment for crippled and nerve racked soldiers, whereby from seventy-five to ninety per cent. of invalided men so treated have been returned to the trenches, should stimulate the whole American medical profession to procure similar results for our own fighting men," Dr. Kinney said in presenting his plan for Government sanction of electricity and light in place of surgery and drugs in combating battlefield casualties. "This large percentage of cures is practically impossible under old methods."

ELECTRIC MOTORS IN NOVEL ROLES.

A large new Western manufacturing plant was made electrical thruout; the human hand and brain were strengthened by that magic force. Because the ten thousand horse power on the two million feet of floor space was to be electrical the production units were arranged with the sole thought of making an unbroken stream of operation which would catch the raw metal in its current at the source and discharge finished valves and fittings at the mouth.

The Nuttiest Job Agoing. One Operative with This Electric Nut-Screwing Device Can Screw Down Nuts at the Rate of 100 a Minute at a Cost of 1 Cent an Hour.

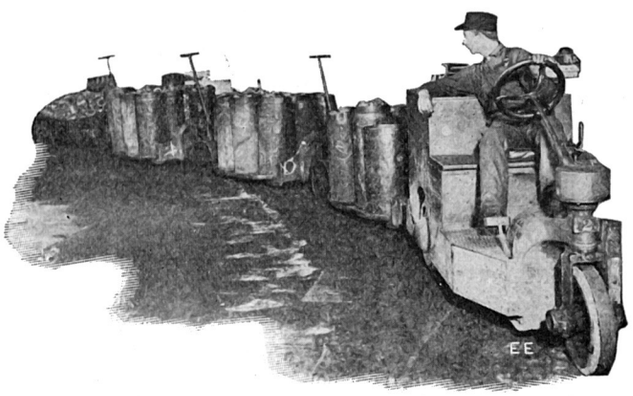
The stream idea of production was so perfected that now the work, where it formerly eddied and swirled, flows thru with the speed of a mill race. Castings are handled red hot,—sorted, tumbled and cleaned, they never stop until delivered to the machine room still warm. The very dust that comes from them is electrically collected and forms a valuable by-product. Every operation is animated by electricity.

Even the day of the spanner wrench has past. Note the accompanying photo of a curious, unassuming little machine used in the assembly room to replace the old hand wrench by screwing down nuts at the rate of 100 per minute, and with a cost of but one cent an hour.

It is difficult for the eye to distinguish brass from iron in a miscellaneous assortment of filings, but here a two horse power motor rotates an electro-magnetic sorting machine which stacks the metal up in two piles at the rate of a ton an hour.

The heavy job of handling the coal for the heating plant is easily mastered by one man with an electric crane at the rate of twenty tons per hour.

The second photo here reproduced shows one of the plant's electric storage battery locomotives. It runs anywhere and everywhere, without having to depend on rails or trolleys. Fourteen electric trains of this type are operated with speeds up to fifteen miles per hour attainable.



Fourteen of These Busy Electric Locomotives Haul Heavy Loads Up to 15 Miles Per Hour In One Industrial Plant. They Operate on Storage Batteries.

MAGNETIC SEPARATOR PULLEY GREAT TIME SAVER.

By Frank C. Perkins.

THE accompanying illustration, Fig. 1 and drawing Fig. 2, shows the construction and method of operation of the magnetic pulleys development at Milwaukee, Wis. These magnetic pulleys are used where coarse material is to be handled, where the iron to be extracted is limited in quantity, and where large capacity is important. This equipment is used extensively to protect crushing and grinding machinery from breakage and damage due to "tramp" iron found in various kinds of material. It is also used for removing iron from material for other reasons, both mechanical and chemical.

It is pointed out that a good magnetic pulley must possess qualities not generally given sufficient consideration. To be efficient a magnetic pulley must be strongly effective at any point on the surface of its face. The magnetism must be distributed as evenly as possible and not be short-circuited within the pulley, but radiate outward far enough to be attractive thru a heavy conveyor belt and any thick layer of material that is to be treated. The area of the surface of a pulley is the width multiplied by the circumference. To thoroly magnetize this whole area so that it will exert the strongest possible attractive power at any point, requires experience in designing and the careful use of every bit of available space from shaft to circumference. The pulley is built of dynamo steel and insullated copper magnet wire.

It will be seen that when completed it is practically a solid mass of metal wire and insulation. The energizing coils are carefully protected from all possibility of mechanical injury by heavy, hard brass shields. When in motion the heat is rapidly dissipated by the conveyor belt, so that it runs practically cool. However, all machinery is more or less subject to abuse by careless operators. Any magnetic pulley left standing idle for a long time with the energizing electricity not switched off, an dthe pulley partly enwrapt in a heavy rubber belt, is liable to become hot enough to injure common insulation.

In order to meet such contingencies and to avoid all possibility of damage from internal heat and to make magnetic pulleys as near "fool-proof" as possible, the very best grade of fire-proof magnet wire and fire-proof insulation is used.

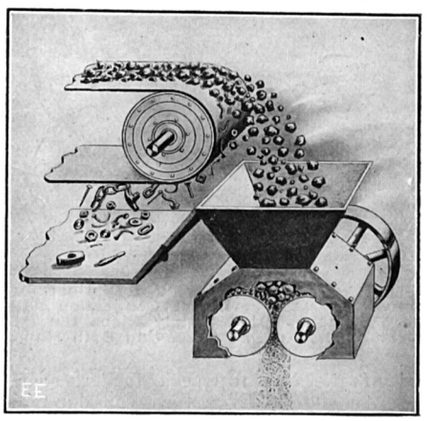


Fig. 1. The Magnetic Pulley Separates Magnetic Substances, Such as Iron, from a Constantly Moving Stream of Mixed Material.

It is urged that the advantages of this separator over the ordinary drum type separator are in its greater magnetic strength; in having no commutator to flash and cause trouble, as the electric circuit is not broken; and in having no brush or scraper to remove the attracted iron.

It will be observed that the operating principle of these machines is very simple. The material to be separated is fed upon a horizontal (or a horizontally inclined) belt conveyor, passing over a magnetized pulley. The non-magnetic material falls by gravity from the brow of the pulley vertically into a suitable receptacle or to a conveyor leading to final delivery, while the iron and magnetic materials are attracted and held firmly against the belt until it is carried to the point where the belt leaves the pulley on the under side and is there discharged back of a partition set a few inches beneath the pulley in line with its axis as shown.

It may be stated that the conveyor is usually a rubber belt of the best grade, heavy, and mechanically strong enough for the material to be handled. It should be made endless, so that no dust or fine material can work thru at the splice. The belts are usually run at a speed of about 100 feet per minute.

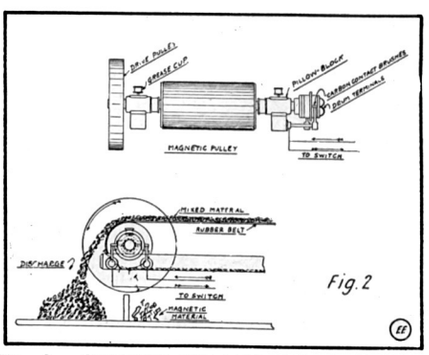
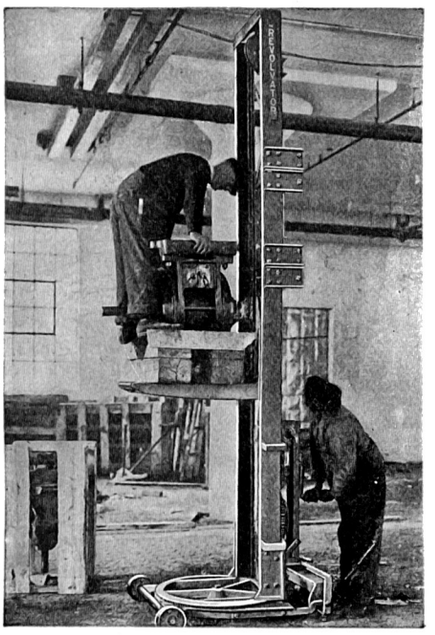


Fig. 2. Sectional and Side Views of New Magnetic Separator Pulley.

ERECTING OVERHEAD MOTORS A CINCH WITH THIS DEVICE.

Recently quite a number of concerns have been using a unique method of putting up overhead motors which permits of installing



A Time and Labor Saver Which Every Electrician Will Appreciate, Is This Latest Portable Elevator for Erecting Ceiling Motors.

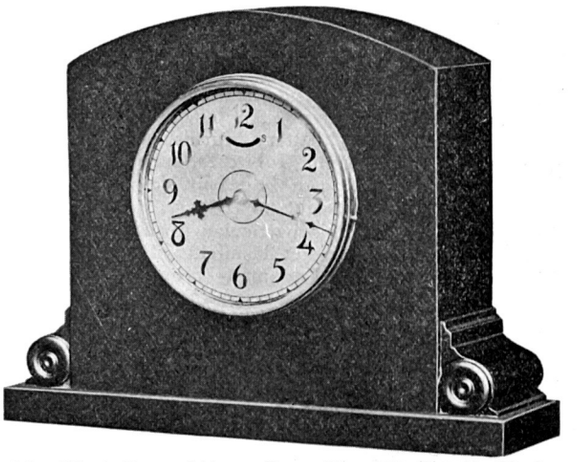
from 4 to 6 motors in the time formerly required for one. This method simply involves the use of a Revolvator, as it is called, to elevate and hold the motor in place until it is secured to the ceiling. It insures absolute safety in elevating the motor and does away entirely with scaffolding, special heavy platforms, blocks and falls and other hoisting arrangements which were formerly used for this purpose.

The Revolvator as may be seen from the accompanying illustrations is a portable elevator or tiering machine. It consists essentially of two uprights or elevator guides, an elevating platform and a revolving base which can swing around on its ball-bearing center like a turntable. The unit is mounted on strong truck wheels and is equipt with a floor lock. A motor or other article to be raised is placed on the platform when down, and by means of a crank and gears the platform is raised to the level desired. In elevating, the load is sustained independently of the crank, for a ratchet is provided with a special patented pawl which sustains the load at every point, eliminating all possibility of the platform being dropt.

The illustration shows the device lifting a 30 H.P. 1400 lb. motor into position.

NOVEL ELECTRIC SELF-WINDING CLOCK.

The idea of a clock that you would never have to wind is very old, and men have spent their fortunes and even their lifetimes in attempting to perfect and market *self-winders*. With few exceptions these clocks were electrically operated, but difficulties arose in each attempt that seemed insurmountable, such as cost of manufacturing, poor electrical contacts, batteries lasting but a few months, and usually the construction was entirely too delicate and complicated for practical purposes.



Why Waste Several Hours Every Year Winding Up Clocks, When the Electric Self-winding Clock Here Shown Will Keep on Going Without a Grumble for a Few Cents a Year?

You never have to wind the electric self-winding clock here illustrated. The *works* or movements are standard timekeepers with the added attraction of being wound electrically by two standard sized dry batteries which fit neatly in the cases. The batteries will run from a year to eighteen months, and new ones can be easily installed by anyone. The style shown is supplied in mahogany and measures 13″ wide, 10″ high and has a 5″ coppered dial.

NEW CORE TYPE TRANSFORMER DESIGN.

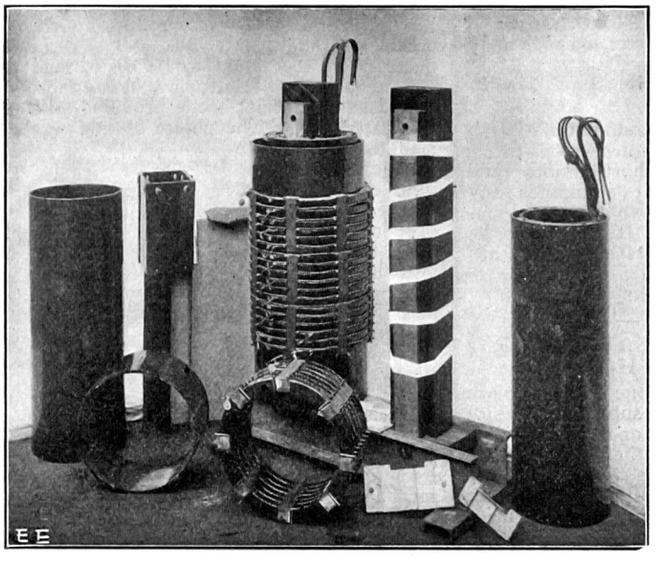
The new core type transformers here illustrated have concentrically arranged high and low tension coils. The low-tension winding is on the inside, and is separated from the high-tension winding by a heavy insulating barrier of Bakelite-Micarta in the form of tubes. These tubes are strong mechanically, have a high dielectric strength, are unaffected by oil, and are in every way the best barrier devised for insulation between high-voltage and low-voltage windings of concentrically wound core type transformers. Ample ventilation is secured in both high- and low-tension windings by means of liberal size ventilating ducts.

The high-tension coil is wound with small round wire. It is given a layer of tape to bind it together, after which it is impregnated in gum. Another layer of tape is then applied, followed by successive dippings in varnish and dryings, in order to fill the tape and give the coil a good gloss.

The low-voltage coil is generally wound in cylindrical or rectangular tube form, depending upon the shape of the core over which it is to fit. It is generally wound with one layer, altho it is not uncommon to have two layers or more, if proper ventilating ducts are provided.

For the lower voltages, the core is sometimes rectangular, but for the high voltages it is usually cruciform in shape. Round coils fit well over a cruciform core and this form is adopted for high voltage windings for which round wire is used.

The coils are braced at the ends of the columns so as to hold them rigidly in place and to prevent distortion or destruction in case of short circuit.



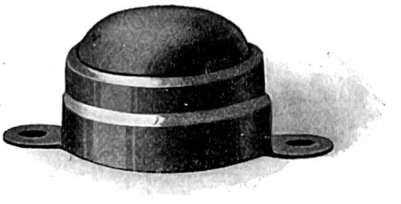
New Core Type Transformers with Concentrically Arranged High and Low Tension Windings.

DIVISION CREATED TO HANDLE ARMY RADIO.

Creation of a radio division under the chief signal officer of the army, to handle radio matters for both the aviation section and the signal corps proper was announced on July 17, by the war department. Major Nugent H. Slaughter, reserve corps, is detailed to take charge.

NEW PUSH BUTTON WORKS WHEREVER TOUCHED.

Here is the latest in push buttons. The entire top is movable so when it is prest at any point the contact is made. The button shell is finished in black enamel, and the top is a black composition, making a neat and attractive article. If you have an electric horn on your car this button will enable you to operate it easier.



This Push Button Works no Matter Where Touched.

EFFECT OF MOON ON WIRELESS.

Mr. J. W. Cohen, a wireless expert, states that while stationed in the tropics for several years as a wireless operator he observed that in the period of the full moon the atmospheric interferences are slight and the ether seems to carry the wireless waves with less absorption than when the moon is in its quarter periods. With the full moon he could receive signals from stations two hundred miles farther away than when the moon was in the first and last quarters.

FLASHLIGHT IN FORM OF BOOK.

The accompanying illustration shows one of the latest novelties in pocket flashlights, the containing case being made in the form of a small memorandum book, which will just fit the vest pocket.

A Flashlight That Resembles a Book.

It is equipt with special high power tungsten lamp and push button on the side in the usual manner. An efficient dry battery furnishes current for the lamp and can be easily replaced at any time.

This particular form of pocket flashlight will appeal to many people for the reason that it does not look like a flashlight, and also it serves as a very appropriate gift to most anyone.

LITTLE THINGS.

Little drops of water,
On the turbine blade,
Make the total horsepower,
Something fierce and great.

Little volts and amperes,
Flowing thru the "grounds,"
Make the meter's reading,
Grow by leaps and bounds.

Little dots and dashes,
Little signals grand,
Span the mighty oceans,
And the busy land.

Little shocks of tension,
Little battery leaks,
Make the 'dabbler's" verbiage,
Emanate blue streaks.

—*By Edward Schultz.*

NEW STEP-DOWN TOY TRANSFORMERS.

The toy transformers here illustrated will operate ordinary toys such as small train outfits, small motors, etc., from the ordinary lighting circuit. The transformer, shown at Fig. 1, has a voltage range of from 3 to 30 volts in 3 volt steps—this eliminates the need of a toy rheostat for varying speeds. It is provided with spring clips for secondary terminals, making it possible for boys to quickly and accurately connect up their toys. There are no binding posts to become loosened or nuts to get lost. The special construction of the voltage regulating lever insures good contact at all times—this prevents sparking at contacts which occurs after short usage in many toy transformers. It has a capacity of 30 watts, or 2 amperes at 18 volts.

For the operation of large sized toys and for other purposes requiring varying voltages, the same concern supplies the Automatic Cut-Out Transformer shown at Fig. 2. For the operation of electrical toys and experimental work, the automatic secondary cut-out not only protects the transformer from short-circuits and over-loads, but it eliminates any danger of injury to toys or apparatus in circuit. It is said to be very positive in its action. It has a capacity of 125 watts, or 5 amperes at 25 volts maximum.

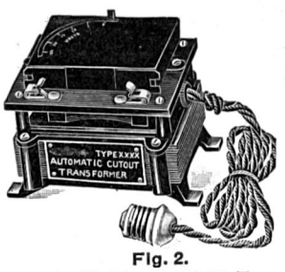


Fig. 2.

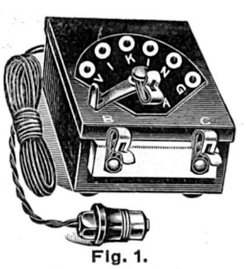


Fig. 1.

Fig. 1, Right, 30 Watt Toy Step-Down Transformer; Fig. 2, Left, 125 Watt Step-Down Transformer.

In the January "E.E."

The January number of THE ELECTRICAL EXPERIMENTER *will be a record breaker. Don't miss it friends. It will be replete with science, electricity, wireless and mechanics. Do you know that thousands of our soldiers and sailors "over there" as well as "over here" look forward eagerly to the monthly arrival of the "E.E."? If they read it to learn the newest things in electrical and radio science, why not you? And don't forget to remail this magazine when you are thru with it. See notice on front cover. For the January issue, among other attractions we offer:*

"The Electric Depth Bomb—Terror of the Submarine," by F. R. Lewis, Military Expert.

"The Electron—Just What It Is"—a remarkable treatment of the subject with some wonderful photographs by Prof. R. A. Millikan.

Baron Münchhausen's New Scientific Adventures, by Hugo Gernsback.

"Machine Shop Kinks for Amateurs"—a new series for the practical man, by Samuel Cohen.

"The Home Treatment of Tuberculosis with High-Frequency Currents"—a most valuable article by an authority—Dr. Frederick Finch Strong, M.D.

"An Electrical Entertainment de Luxe," describing a host of unusual and instructive experiments as presented by Mr. William J. Hammer.

"Ham" Aerials—A wireless tale with a kick, by W. J. Howell.

Detail Construction of a Damped and Undamped Wave Receptor. With full working drawings by F. Mac-Murphy.

A New Electrical Time Recorder, by H. Hartman, C.E.

The First Edison Electric Light Station—with some interesting photos.

BATTERY SAVER FOR TELEPHONES.

On rural telephone lines there are often times when subscribers desire to "listen in," as for example, when market and weather reports are being issued from the central exchange. This "listening in" habit is a great battery consumer and to eliminate it, but at the same time preserving the farmer's joy, a progressive telephone manufacturer has devised the simple battery-saver illustrated.

The invention consists of a latch device which is made to attach to the hook switch

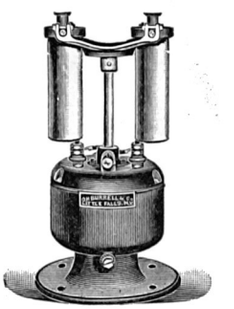
This "Battery Saver" Telephone Attachment Permits One to Listen in on a Line Without Wasting Battery Current.

escutcheon plate on the left side of the instrument. When the receiver is removed from the hook the lever springs up but is caught half-way by the bent finger of the battery-saver latch. In this position the circuits of the telephone are connected so that the user may hear but not talk; the transmitter is not connected to the battery and no current is consumed.

If the person using the telephone wishes to talk he presses the latch back as in illustration herewith. This disengages the hook switch lever and allows it to resume its upward movement to the full operated position. When the lever is in this position the battery is connected to the transmitter and telephone may then be used for talking purposes.

A MOTOR-DRIVEN MILK TESTER FOR DAIRYMEN.

This is a machine for rapidly and accurately determining the percentage of butter fat in milk and milk products, such as cream, skim milk, buttermilk, etc. A definite quantity of the liquid to be tested and a definite quantity of sulfuric acid are thoroly mixed in the special bottle provided with a graduated neck. The object of adding the acid is to dissolve all the solids in the milk except the fat. Its strength must be proper for this purpose, say about 1.82 specific gravity. This bottle is then rotated at sufficient speed so that the centrifugal force generated throws the lighter part of the liquid, in this case the butter fat, up into the neck of the bottle, where its percentage of the total amount may be read. Such a machine is nominal in cost and saves much trouble and work for dairymen.



Motor-driven Milk Tester.

AMONG the hundreds of new devices and appliances publisht monthly in The Electrical Experimenter, there are several, as a rule, which interest you. Full information on these subjects, as well as the name of the manufacturer, will be gladly furnisht to you, free of charge, by addressing our Technical Information Bureau.

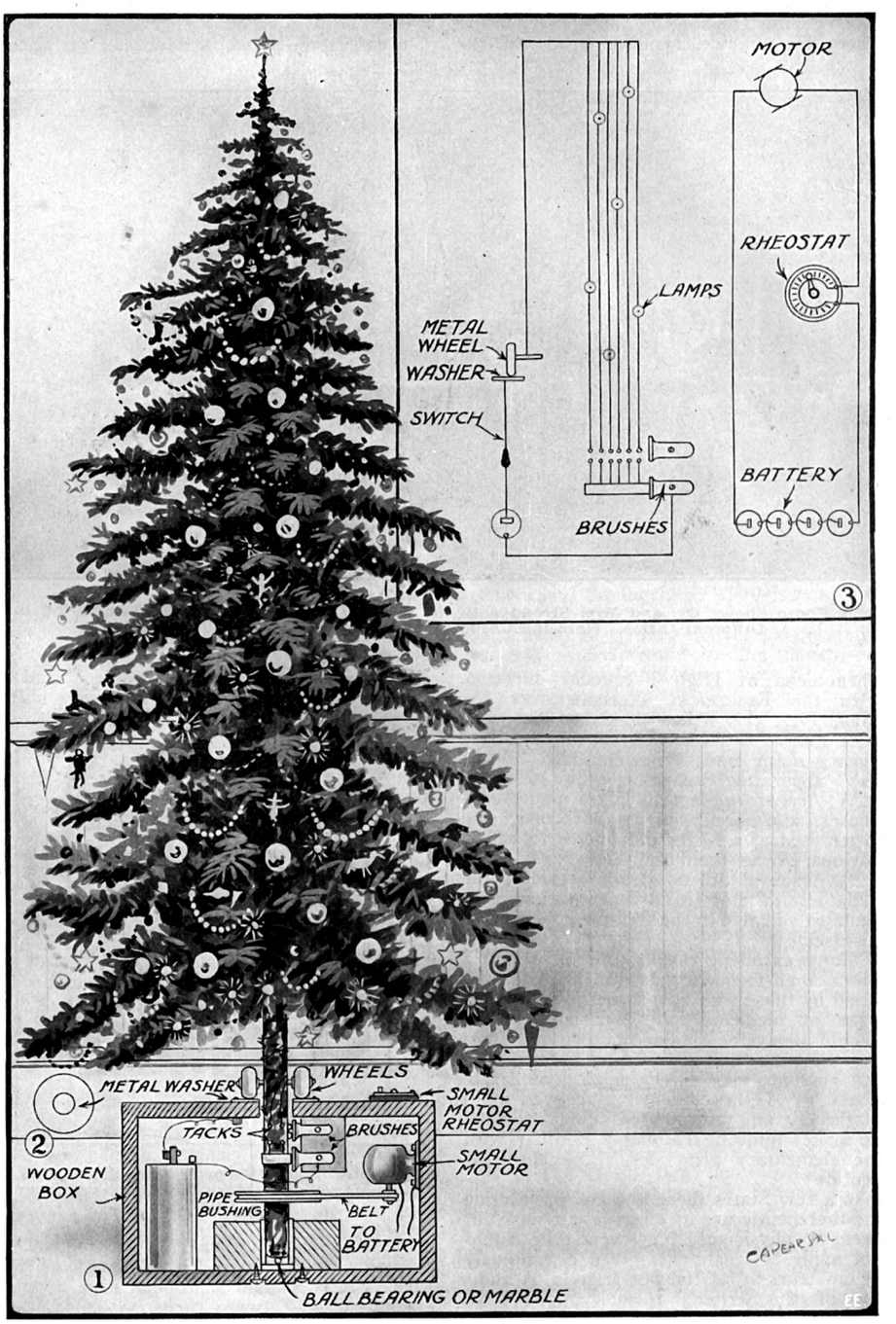
A Revolving Electric Christmas Tree

By JOHN T. DWYER

FOR those experimenters who have not a storage battery or whose homes are not equipt with a 110 volt house circuit, it is a difficult matter to rig up an electrical Christmas Tree display, even with only six or eight lamps, as for efficient results, it generally takes about a half dozen dry batteries at the least, and at the present "war prices" this is prohibitive to the average "mucker". However, the hook-up here shown not only possesses several novel features but can also work well on as low as six batteries—two for illuminating the lamps and the other four for running the motor. This is made feasible by the fact that only one light is brought into the circuit at a time and, as the revolving of the tree by means of the motor (see Fig. 1) automatically makes and breaks the circuit to each lamp alternately, the result is a charming "twinkling" effect, which is very pleasing to the observer.

While the drawings are practically self-explanatory, a few remarks concerning some of the details may make them even more readily understood. Regarding the two wheels in Fig. 1, these act as a smoother bearing for the revolving tree and may be obtained from either an old pair of roller skates or else discarded furniture castors. The axle on which they turn passes thru the stem, or trunk of the tree, and has soldered to it the main wire in the circuit. The metal disc or washer shown in Fig. 2, can be made from the bottom of a tin can but must present a flat surface. The commutators, of course, are preferably of brass and it will be noticed that one is connected directly to the battery while the other acts as a closing switch between the upper and lower contact points. These latter are simply round brass headed tacks, hammered into the tree and their number depends on how many lamps are employed. For the purpose of regulating the speed of the motor, a rheostat of the small coil type available on the market, should be used, and if the reader has not this instrument, he may readily construct a simple one in a few minutes by referring to back numbers of the ELECTRICAL EXPERIMENTER magazine.

The wiring diagrams are shown in Fig. 3. Provided that the tree is a small one, say not over 4 ft. in height, a toy motor will be strong enough to revolve it freely. For the purpose of cutting out the lighting circuit, as during the day-time, without however interfering with the motor, a switch may be inserted as shown.



The Electrical Xmas Tree Can Be Made Twice as Charming by Arranging It to Revolve in the Manner Illustrated. The Groups of Lamps Blink on and off Alternately, Giving a Most Beautiful Effect That Will Please Kiddies as Well as Grown-ups.

RADIO BETWEEN SAYVILLE AND HAWAII.

The navy's new wireless station at Pearl Harbor, Hawaii, has a radius of five thousand miles, and its opening on September 29th, was signalized by an exchange of messages with the station at Sayville, Long Island. When the stations now building in the Philippines are completed communication between Washington and the Philippines can be carried on with only one relay by way of Honolulu.

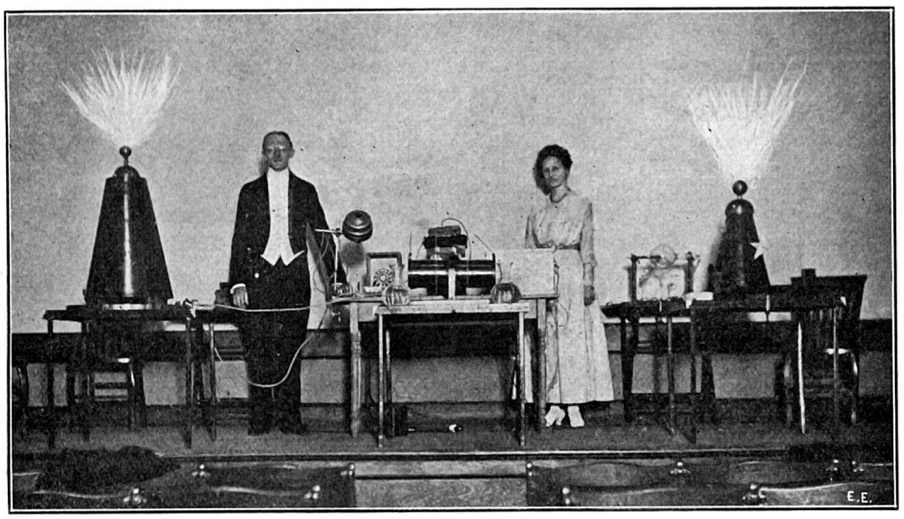
The Pearl Harbor equipment makes it the most powerful radio station in the world. It is one of a chain of high power radio stations under construction by the Navy Department. The principal stations completed in the chain are at Arlington, near Washington, at Darien, in the Canal Zone, and at San Diego. The remaining stations, at Cavite, Philippine Islands, Guam and Tutuila, will be completed in the next two months. The outfits include three masts at each station to support the aerial, each mast being of steel and self supporting. The apparatus is of the Poulsen arc type, which is standard in stations of the high power chain. Suitable and comfortable quarters are provided for the personnel of each station.

Wireless telegraphy has been wonderfully developed since the experiments made by officers of the United States Signal Corps during the Civil War. These began with the use of water-courses to carry the current. Aerial telegraphy was then attempted and demonstrated to be practicable for short distances in experiments whereby messages were transmitted from one height to another across valleys in the Cumberland Mountain region. As late as the period of the Spanish War it was possible for Dewey to debar the Philippines from communication with the outside world by cutting an ocean cable—a feat which cannot be repeated, for progress in electrical science has been going forward with electric rapidity since the spring of 1898, and the world is now in a new age, the age of *wireless telegraphy.*

How to Use High Frequency Currents in the Treatment of Disease

By Dr. FREDERICK FINCH STRONG.
Lecturer in Electrotherapeutics, Tufts Medical School, Boston

NOW that the exigencies of war have temporarily suspended the activities of amateur Radiotelegraphers, many of those possessing transmitting outfits are using them for the experimental study of the



This Photo Shows Dr. and Mrs. Strong with the Elaborate Apparatus Used in Lecturing in Different Cities. Note the Large Conical Oudin Coils in Full Activity.

phenomena of High Frequency currents.

In the ELECTRICAL EXPERIMENTER for May, 1917, the writer described the construction of a Tesla D'Arsonval high-frequency outfit made from standard "Wireless" apparatus, consisting of a ¼ or ½ K.W. transformer with glass plate condenser and oscillation transformer, the latter used as a series inductance to obtain various effects from the Tesla coil, or as a "D'Arsonval Solenoid" for obtaining the "Diathermic" and "Auto-condensation" currents so valuable in the treatment of certain diseases.

Many excellent results can be obtained from high-frequency treatment administered by those who have little or no knowledge of medicine. A physician's advice should always be obtained before undertaking the treatment of any serious case, but the amateur may safely employ moderate doses of Tesla currents, and even mild diathermy and autocondensation, provided he makes himself reasonably familiar with the elementary principles of electrotherapeutics.*

In a few States there is a law prohibiting the therapeutic use of electricity by any but licensed physicians, but even this would not apply to treatments given gratuitously by amateurs to relatives or friends. A number of the writer's former pupils have become successful practising electrotherapeutists, altho they are not physicians. Most of them wisely refrain from the use of the sinusoidal, Galvanic and static currents; these belonging more to the field of the electro-medical specialist.

A simpler and cheaper apparatus than the one described in the May issue of this journal will give all the varieties of therapeutic high-frequency currents that may safely be used by the amateur. It is made up as follows:—

Transformer,—Any standard ¼ K.W. radio transformer (E. I. Co., Clapp-Eastham, Thordarson, etc.)

Condenser,—Standard wireless glass plate condenser, one section of .005 microfarad; two sections of .01 m.f., each in series will be safer.

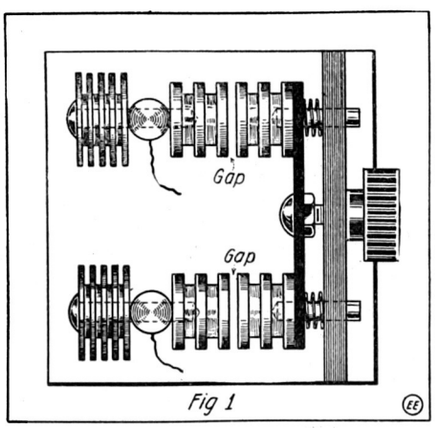


Fig. 1. A Simple Form of Fixt Spark Gap, Found Very Satisfactory for High Frequency Outfits.

Inductance Coil, ("D'Arsonval" solenoid), thirty turns No. 12 bare copper wire, wound around a wooden cage 8" in diameter., ¼" between turns.

Spark gap,—Adjustable series gap, made as shown in the diagram, Fig. 1. The sparking surfaces are of copper, turned in annular or concentric grooves as described in a previous article. Copper washers of ½" and 1" diameter, are slipt alternately on an 8-32 machine screw, and form the heat radiating wings. The further construction and operation of the gap is indicated in the drawing.

Tesla Coil,—Identical in winding to that previously described, viz.,—secondary—on a 2" diameter paper mailing tube wind 480 turns of No. 34 S. C. C. magnet wire (40 turns to the inch; 12" winding, 1" margin on each end). Slip the secondary into a 4" mailing tube, center accurately by means of three corks in each end, seal one end by standing coil on end in a shallow pan filled with melted resin, and when cold fill the annular space between tubes with a mixture of beeswax (yellow) one part, to resin, 5 parts. Wind primary, consisting of six turns "Magneto" cable (which can be bought for five cents a foot) around center of outer tube; turns spaced ½" apart. Secondary leads, of magneto cable, should be connected to the outer posts of the writer's "triple terminals." One arrangement of the complete apparatus is shown in Fig. 2. The triple terminals greatly facilitate the therapeutic use of the Tesla Currents, and also afford an opportunity for studying different forms of the high-frequency discharge. The actual terminals, A and C, are formed of two moulded high-tension insulators, surmounted by 2" brass bed balls, (known to the furniture trade as "brass vases"); thru terminal A slides a brass rod having a rubber or hard-wood handle on the outer end, and a 3" flat brass disc on the inner end. Terminal C is similar but has a small brass ball on the inner end of the sliding rod. A "Dummy" terminal, B, is mounted as shown, midway between the actual terminals. By closing the gap between the brass discs and opening that between the balls B and C, an arc discharge is obtained, while by closing gap B C, and separating the disc electrodes, the discharge forms a beautiful purple brush or "effluve."

In giving treatments the patient is seated on a folding *condenser pad* of thin fibre of Bakelite, Fig. 4, backed with copper or tin foil to which is attached an insulated cord connected with terminal C. The operator will require a set of vacuum electrodes, Fig. 5, a metal hand electrode formed of an eight-inch length of 1¼" nickeled brass pipe, "effluve" electrode made from the gong of an old electric bell screwed on the end of a hard-wood handle, and two pieces of sheet block tin 3" x 3" x 1/32" with insulated conducting cords soldered to their corners, Fig. 6. The condenser-pad can be obtained from any electro-therapeutical supply house, as also the vacuum electrodes and other materials.

For ordinary general treatment to promote nutrition, increase circulation and elimination—a treatment of value in almost any condition of impaired health—the balls and discs are widely separated and

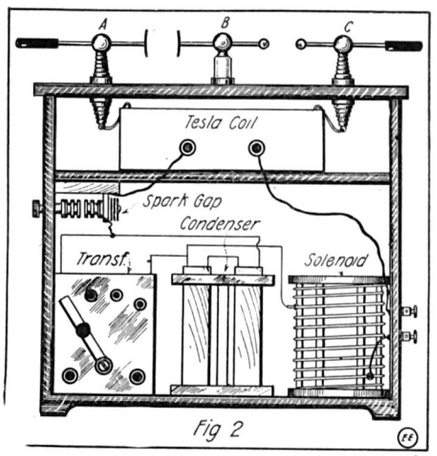


Fig. 2. Assembly of Apparatus in the Author's High Frequency Therapeutic Outfit.

* The new edition of the writer's book, "Essentials of Modern Electrotherapeutics," now in press, gives all needed information, with an alphabetical list of various diseases and the method of treating them electrically.

the patient is seated on the condenser pad connected to the terminal C. Open the spark gap until a vacuum electrode lights up when held about a foot from the patient: this shows that the body is being charged inductively to a high potential, the charges alternating some 1,500,000 times per second. The patient feels nothing and is absolutely insulated from all electrical connection with the apparatus, yet hot sparks can be drawn from any part of the body showing that the whole organism is being subjected to a rapidly alternating molecular massage, which has the effect of increasing all the vital functions without acting as a stimulant. In other words the treatment tends to bring the patient into a normal condition, but it has no more effect upon a perfectly healthy person than pouring water into a pail already full. This is the reason why high frequency treatments may be safely given by those who are not physicians, whereas all other forms of therapeutic currents act as stimulants or counter-irritants and must be employed with precise knowledge and discrimination.

The condenser treatment as described above, is usually given for about fifteen minutes after which the bulb-shaped vacuum electrode is applied for a few minutes over the spine and solar-plexus. It is applied either directly to the surface of the body or thru one thickness of clothing. The insulating handle of the vacuum electrode is connected to the middle post B, in Fig. 2, and after turning on the current and placing the electrode on the patient, the discs A and B, are closed, being opened again before lifting the electrode from the surface of the body: if this is not done painful sparks will pass from the glass electrode to the patient. In treating obstinate cases of recurrent neuralgia, chronic rheumatism and partial paralysis, this vacuum sparking treatment is often beneficial, but it is rather unpleasant for most cases. A milder form of this counter-irritant effect is obtained by using the vacuum electrode over two or three thicknesses of clothing; it must be moved rapidly from place to place, otherwise the skin might be blistered.

For sedative effects and to reduce local inflammation and congestion, the vacuum electrode should always be applied directly to the skin or mucous membrane; this applies to such conditions as acute rheumatism, neuritis, tonsilitis, etc., an acute "cold in the head" (coryza) can often be aborted in one treatment by the above technique, using the vacuum electrode over the nose and the thin slender vacuum electrode in the nasal cavity.

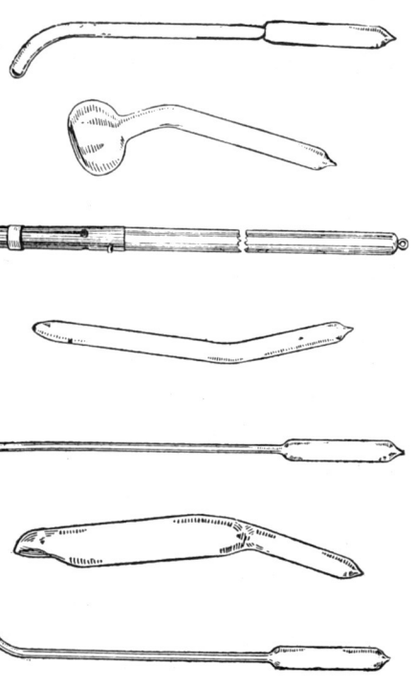


Fig. 5. Various Forms of High Frequency Treatment Electrodes. They Are Made of Glass.

In treating skin diseases, such as eczema and acne, where we wish to avail ourselves of the antiseptic and tonic effects of the "effluve," we connect the effluve electrode in place of the vacuum electrode, close the discs and gradually approach the bell of the electrode to the patient until a full, blue violet effluve plays upon the surface to be treated (see Fig. 3). To obtain the best effluve effects several turns of the tuning coil should be used in series with the Tesla primary (see article in May issue). The effluve is also valuable as a general tonic in sluggish conditions of the digestive system, also in nervous depression and functional nervous diseases.

For the relief of abnormal arterial tension—("high blood-pressure"), and in the treatment of *arteriosclerosis*, as well as in conditions involving excess of uric acid, we employ "D'Arsonval autocondensation." To obtain this current we short-circuit the Tesla primary by means of the single-throw switch, and attach the condenser pad to the lowest turn of the "Solenoid" or tuning coil. The patient clasps both hands around the metal "pipe" electrode connected to the upper turn of the coil, the current is turned on and the spark-gap opened until a pleasing sensation of warmth is felt flowing up the patient's arms. In all regular therapeutic high-frequency outfits, a hot-wire milliamperemeter is placed between the patient and the machine. This is not necessary in connection with the above described apparatus, as it only delivers a maximum of 800 milli-amperes to the patient—an amount well within the limits of safety. In chronic cases autocondensation should be given daily in twenty-minute treatments. This treatment should never be given immediately after eating, or in cases of "Bright's Disease," or in organic heart trouble. High frequency treatments are of great value even in these conditions, but they should be applied only by a skilled specialist.

Fig. 3. Showing How a Patient Is Given the High Frequency "Effluve" or Spray Treatment. The Patient Sits on a Folding Condenser Pad Placed in the Chair.

Figs. 4 and 6. Condenser Pad Used for Giving Auto-Condensation Treatment and Auxiliary Tin Electrode.

In inflammation following acute infection, as in acute bronchitis, incipient pneumonia, etc., we employ "local autocondensation" or "indirect Diathermy." In this method the patient sits upon the pad as for autocondensation, but instead of the metal handle we employ one of the plates of block tin; this is applied in close contact with the skin over the affected area, covered with a folded towel and held in place by the patient; a sensation of deep penetrating heat is felt, and relief from the pain and congestion follows. This is one of the most valuable methods in electrotherapeutics; were it available for the general practitioner, or better still, in the patient's home, there is no doubt but that nine-tenths of the cases of acute local infectious disease could be aborted. This is also of great value in the treatment of asthma.

Statistics show that one-seventh of all recorded deaths are due to Pulmonary Tuberculosis ("Consumption,"): proper treatment in the home by high frequency currents would greatly increase the percentage of recoveries from this dread disease. Dr. Howard Van Renssellaer of the Albany Tuberculosis Hospital has reported 80% of cures by high frequency treatment, and an even higher percentage is reported by Dr. Alfred Geyser of New York. The writer feels that this subject is of sufficient importance to be treated in a separate article, which will appear in next month's ELECTRICAL EXPERIMENTER under the title "The Home Treatment of Tuberculosis with High-frequency Currents."

The RADIO LEAGUE of AMERICA

HONORARY MEMBERS
CAPT. W.H.G. BULLARD, U.S.N. NIKOLA TESLA.
PROF. REGINALD FESSENDEN. DR. LEE DE FOREST.

H. Gernsback, Manager — *W. H. Kirwan, Master of Radio Relays*

The Spirit of 1917

AMATEURS of America! Read the accompanying letter, and after you have read it, read it again. If you are a red-blooded American Radio Amateur, to whom the honor of his country means anything at all, you cannot fail to see the moral contained in Mr. Leland Allen's letter.

Here is a young man with wife and children dependent upon him, and who as a rule would be readily excused from serving with the colors. But no! HE realizes for what ideals this country is fighting. *He* is willing to do his share, nay, lay down his very life if need be to make this world free for democracy. *He* knows that this is not just an ordinary small war. *He* don't think about letting the other fellow do the work. Far from it. *He does* know that if we don't fight the enemy "over there," we surely will fight him over here, just as sure as the sun will rise tomorrow.

Now fellow amateurs what are YOU doing about it? Does it not make you blush when you read Mr. Allen's letter, while you sit securely in your home, fooling away your time? Where is your far-famed and oft' boasted American fighting spirit? Don't you single fellows with no *real* ties to keep you home, feel small and ashamed of yourselves, when the married men come forward, while you do nothing? Red-blooded Americans! Yes, where are they? Hiding in the security of their homes. And you pride yourselves as being the descendants of Washington and Lincoln! Both would blush with shame were they to return today to witness the spectacle of seeing only 1,000 Amateurs out of a possible 300,000 step forward to do their share for their glorious country. For up to this writing only about one thousand amateurs have shown their willingness to help their Government by becoming operators in either the Army or the Navy. Just think! 1,000 out of 300,000! What a disgrace to the Radio Fraternity!

Could you blame the officials in Washington after the conclusion of the war if they said:

"We have before us the question of reopening the Radio-amateur stations. The American amateurs demand of their Government the free use of the ether. They had it before the war. Of all countries in the world, the American amateurs had the greatest liberties. These liberties were given them so that in case of war the Government would be assured of obtaining an unlimited number of operators. Now let's see what happened. The war came and the Government wanted operators. It needed some 25,000 of them. Rather a small percentage out of a possible 300,000. Did the Government get these operators after sending out distress calls thru the daily press and thru the technical publications? Not much. Either there are no Radio amateurs in the United States or their Americanism has gone bankrupt. In either case let's wash our hands of the matter. If the amateurs don't need their Government, the Government does not need the amateurs, who at best are a nuisance anyway. Seems to us that these fellows don't believe in the doctrine of 50-50. Their religion is 90-10—ninety for themselves and a bad ten for their Government! Move that we "can" the whole tribe! The Amateur Radio Stations STAY CLOSED. Finis!"

Now Amateurs this is exactly what will happen if the situation does not improve. soon. No, we are not as a rule calamity howlers, but we can see ahead of the times, and frequently we have our ears to the ground. We know what's coming, but you apparently do not. If you did, you would come forward and sign your application blank.

Now before you close this magazine, go into your den where no one watches you and have speech with yourself. Just say:

"What on earth is wrong with me anyway? Why am I such a confounded, slow-moving, unappreciative, unimaginative, good-for-nothing radio-slacker? Yes why? I am a husky brute, know all about Radio that's worth knowing, (and then some), eat three square meals a day, loaf a good deal, act the great knows-it-all when the girls are around, but my patriotism has gone bluey. Of course nobody suspects this but myself. When I am with the gang I can wave the Stars and Stripes and shout *"Amerika über Alles"* as well as the best of them! To be sure I mean to sign that old "Radio Honor List" blank *sometime*. But why hurry? Let's first see how many others sign it. Then *sometime* I'll sign it too.

"Yes, let the other fellow be the patriot first.

"But why do I always put things off till tomorrow? Why? I really ought to know better. This procrastination of mine has given me nothing but trouble all my life. It has been my greatest single liability—my great handicap. *Some day* it will cost me my neck . . . . *Damn some day . . . . damn tomorrow . . . .* I'll sign that blank NOW!"

P. S. And be sure to mail it tonight!!

H Gernsback

Woodbine Light and Heating Company
LELAND ALLEN, ENGINEER.
WOODBINE, - - IOWA

October 4th 1917.

The Radio League of America.
233 Fulton St.
New York City.

Gentlemen:-

You will please find enclosed the membership blank , filled and signed. I have a family to support but I will start the ball rolling and send in my membership card. If dear old Uncle Sam wants me I'll be there. Of all the single fellows that had wireless sets , and to have hung off this long when the chance of thier life-time is now calling them. The government ought to have been over-run with applications. But if need be , I will step forward , leaving behind a wife and two babies.

Yours for Radio,

Leland Allen

RADIO WRITERS — ATTENTION ! ! !

Can you write radio articles dealing with the practical problems of wireless operating? We can use some good papers on such subjects as "the tuning of radio transmitters"; "the use of the wave meter, including its application to measuring the frequency, wave length and decrement"; "operation of commercial transmitting and receiving sets"; "the operation of army trunk sets"; "improved ways of receiving undamped wave signals," also new ideas and short-cuts for learning the codes. We pay well for all articles accepted. Help yourself, your magazine and your country.

Radio Roll of Honor

Editor's Note. For obvious reasons, the city addresses of the applicants listed below have been left out. Only the name of the Radio Amateur as well as the State in which he resides have been publisht. Every applicant listed in these columns has pledged his services to his country as a radio operator.

All honor, and our sincere congratulations to every young man whose name appears here.

Alabama

Harold L. Mitchell
Paul Draper

Arkansas

Miles Sharp
J. Walter Moore

Arizona

W. N. McKnight
W. H. Buntin

California

Hugo Pearson
H. J. Schnarr
James Glenn
Floyd Hollister
E. E. Twombly
Arthur Munzig
John Stevens
Wm. G. Harris
William Siegel
Joseph A. Axen, Jr.
Howard R. Lee
Jack Rosenberg
Geo. Shong
David Spowart
Roy A. Wilkins
Gilbert A. Trosper
G. A. Trosper
A. W. Martin, Jr.
Chas. F. Filstead

Colorado

Elliott Buchanan
Ed. B. Landon
D. P. Deich

Connecticut

Leslie A. Didsbury
Bud Hartman
Howard Simons
C. S. Keatinge
Walter Payne
Arthur Barney
Ed. J. Heffernan
Suno Larson
F. A. Mulvihill
Wm. F. Murray
William H. Mansfield, Jr.
Adelmer R. Bryon
E. Gaynor Brennan

Delaware

R. A. Gentman

District of Columbia

Edwin A. Emerson
Barton White

Florida

R. C. Holtzclaw

Georgia

Edward Merritt
C. D. Short
Geo. Hamilton

Idaho

Floyd Taylor
Loy Hagerman
Robert Eldridge

Illinois

Folke Martin
Wm. Schrand
H. N. Johnson
Otto Meyer
H. E. Bergae
E. A. Blum
O. L. Keller
C. N. Larson
Richard Rea
Earl Pratt
B. F. Chiles
Jos. H. Chapman
Rowell Herrick
Wm. J. Langan, Jr.
Marvin Messing
Leo. L. Hamilton
Marcus Potter, Jr.
Stanley G. Jones
Ira F. Coon
Lawrence Armantrout
P. J. McGee
R. J. Iversen
Verner Hicks
T. S. Lively
Chas. Bare
Kenneth Baldwin
Chas. D. Thomas, Jr.
Jesse D. Weast
R. C. Kingsley
H. O. Reitsch
Chas. Coe
Harold Sever
Carmi Edward Miller, Jr.
E. Jerome Wolff
Walter S. Franseen

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Leroy F. Bremmer
Paul D. Anderson
G. Windenburgh
F. Starzl
Homer D. White
P. A. Stover
Ray Farmer
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Glenn F. Dunfee
B. Harold Miller
Leland Allen
R. H. Smyth

Indiana

Robt. H. Douglass
Richard Boharavoz
W. H. Keller
Clarence F. Kramer
H. A. McIlvaine
C. A. Powers
Leland Miller
G. Bloom
H. Schlemmer
Tom Frazer

Kansas

Carl Paulsen
D. I. Shepherd
J. L. Smith
W. T. Wilshusen

Kentucky

Elby Becker
Lawrence O. Davis
E. A. Hahn
Oscar Ward

Maine

Elwell C. Dyer
Walter Marr
Walter G. Stone
C. A. Rounds
Emery D. Austin
Harold Wilson
Reginald J. Curtis

Maryland

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Allan C. Poore
Paul A. Burrier

Massachusetts

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Wm. Lewis
G. A. Werner
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M. Stearns
Arthur Bremilst
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Robt. J. Engler
M. Swanson, Jr.
Robt. Hall
M. Bergstrom
Sam Wilkeson

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E. S. Bodine
Hall Anderson
Arthur S. Hughes
Chas. Albert Pfisteres
Irwin Umbright
Lawrence Wilhelm
A. L. Fluesmeier
Lawlon Andrews
Joe P. Rynearson

RADIO AMATEURS! IS *YOUR* NAME HERE?

The Editor of THE ELECTRICAL EXPERIMENTER has patriotically proposed the "Radio Roll of Honor," the first signatures having been publisht in the November issue. Let every Radio Amateur and Expert not at present engaged on work for the government or in the government service sign the blank on page 571. Red-blooded Americans, it is the least you can do. Uncle Sam needs your services NOW! not next year or the year after that. He is calling for tens of thousands of RADIO OPERATORS—not thousands. No other country in the world treats its fighting men better than the United States. The food, clothes, and pay are right. Advancement is rapid and sure. If you are ready to help your country sit right down, sign the appended blank, and mail it to us. We will record your name for next month's "Radio Roll of Honor" and forward the blank to Washington. Come on—"Buck Up" as Tommy Atkins says, and sign up. We have got to have thousands of names.

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Thomas Saunders
A. H. Mitchell

South Dakota

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John A. Miller
Alfred Shaw

(*Continued on page* 571)

Notice to All Radio Readers

As most of our radio readers are undoubtedly aware, the U. S. Government has decided that all Amateur Wireless Stations, whether licensed or unlicensed, or equipt for receiving or transmitting, shall be closed.

This is a very important consideration, especially to those who are readers of THE ELECTRICAL EXPERIMENTER, *for the reason that we desire to continue to publish valuable articles on the wireless art from time to time, and which may treat on both transmitting and receiving apparatus. In the first place, there are a great many students among our readers who will demand and expect a continuation of the usual class of Radio subjects, which we have publisht in the past four years, and secondly, there will be hundreds and even thousands of new radio pupils in the various naval and civilian schools thruout the country, who will be benefited by up-to-date wireless articles treating on both the transmitting as well as receiving equipment. Remember that you must not connect up radio apparatus to any form of antenna.—The Editors.*

Some Interesting New Radio Apparatus

THE interesting new radio apparatus shown herewith has been recently developed by Mr. Melville Eastham, the well-known radio engineer, and much of it has been recently employed for use on Government radio equipment. The apparatus is of particular interest to radio experimenters, as while it is of first class design and workmanship, the cost of the instruments is very nominal.

A correctly designed direct-reading wave meter is unequaled in many points, convenience and ease, and speed of readings being important features to consider in all ordinary classes of work with a wave meter. When we achieve accuracy, essential in any wave meter, and extreme compactness and portability, we have an instrument peculiarly adapted to some uses,—such as tuning up transmitters on submarine-chasers, etc. Within the wave lengths adapted to it the wave meter shown in Fig. 1 is unapproached in convenience.

This wave meter is constructed to read from 300 to 1000 meters, resonance for transmitted signals being indicated by a sensitive hot wire meter. For use with required signals a simple crystal detector is mounted on the panel, with binding posts for 'phones. The wave lengths are read directly from a scale which passes beneath a circular window with cross-hair. The inductance is mounted beneath the panel, out of sight, together with the variable air condenser and the body of the hot wire meter. The entire instrument is mounted in a strong oak box which measures 8½ by 5½ by 5½ inches, with a handle for carrying; the total weight is 4¼ pounds. There are no adjustments to be made at any time—simply hold the meter a few feet from the helix, and on the maximum deflection of the hot wire meter, read the wave length directly from the circular window.

The laboratory type wave meter shown

(*Continued on page* 577)

Fig. 1. New 300 to 1,000 Meter Range Direct-Reading Wave Meter. A Hot Wire Meter Indicates Resonance.
Fig. 2. Laboratory Style of Wave Meter Which Is Fitted With Thermo-Couple and Galvanometer, as well as Phones, Detector, Buzzer, etc.
Fig. 3. Radio Relay Key Good for 5 K. W. Equipt with Emergency Lever.
Fig. 4. Flame-Proof Key for Use on Balloons and Aeroplane.

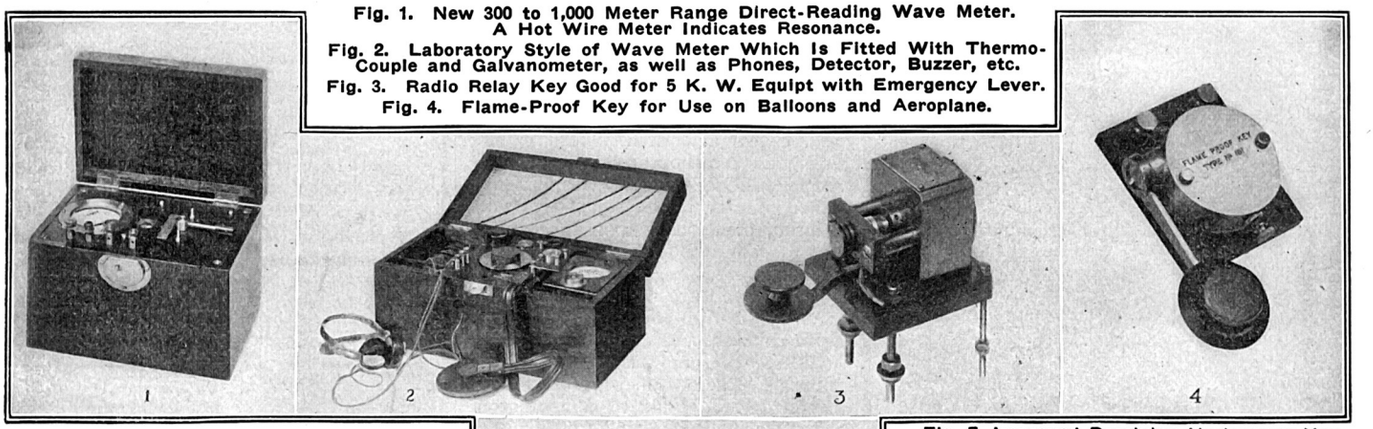
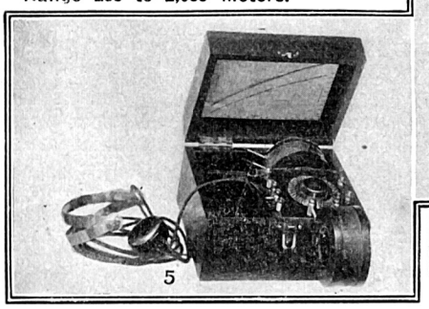


Fig. 5. Wave Meter of Similar Pattern to That in Fig. 1, but Uses 'Phone and Detector to Determine Resonance Point. Normal Range 200 to 2,600 Meters.



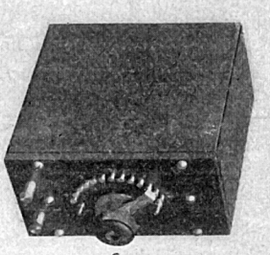
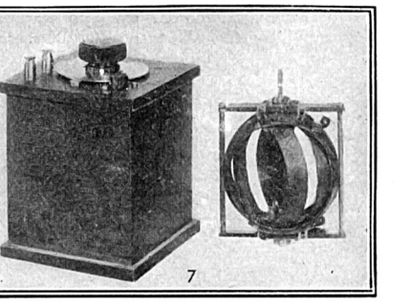


Fig. 6. A Variable Step Inductor for Use in Audion Regenerative Circuits. Coupling Is Possible by Placing One Coil Box On Another. Has No-End-loss Switch.

Fig. 7. Improved Receiving Variometer Having Three Windings, Connected to a Special Switch Permitting of Series and Parallel Combinations of the Coils. Coils Are Wound Self-Supporting.



BLIND OPERATORS IN THE GERMAN ELECTRICAL WORKS.

The authorities in Brandenburg, Germany, have been endeavoring to find occupation for men who have lost their eyesight, and a number are now being employed in the Siemens-Schuckert Electrical Works. They are found quite serviceable for such work as gaging small parts, stamping numbers, packing small articles and testing fuse plugs acoustically. A room is given up to their working, and special precautions are taken in the location and fencing of machines and the elimination of sharp projections that might cause injury. The workers are paid a minimum wage of 28 pf. (about 7 cents) per hour, but some earn as much as 55 pf.. (about 14 cents). It is stated that they prefer machine work to hand work, the noise of the machines being apparently a useful guide to the progress of each operation.

PHONOGRAPH TEACHES WIRELESS CODE QUICKLY.

Perhaps the most useful application of the phonograph to the radio art at present is its adaption to the teaching of the Wireless Code. By the aid of new records invented by Mr. Walter P. Phillips, author of the Phillips code, it is possible to use them on the regular home talking machine, and learn the code without any expensive apparatus.

There are two ways of learning to read by sound. The old way was to have the letters very slowly made with dots and dashes at long intervals apart, and painfully guest out by a combined effort of the intellect and imagination. But the letters made in this manner do not sound as they do when the dots and dashes are placed in close connection, as the pupil must eventually learn to read them. The true way to learn to read by sound is to follow regular and moderate sending from a written or printed slip. In this way the letters reach the ear as they will always sound, and it is not difficult with a copy of the message being ticked out before one to follow it.

The phonograph is an ideal and perfectly adapted machine for this purpose, and it hardly can be realized that it was not invented for this particular purpose. The code records come in a set of eight 10-inch discs—one lesson on each side, making 16 lessons in all, after which time it is possible for the student to advance rapidly.

It is well known that students invariably copy the style of their tutors. Realizing this, only the best of professional men have been chosen to make these records, and the operator chosen for this task holds the Diamond Medal for proficiency in the art.

The Phonograph Has Proven Extremely Valuable in Teaching the Radio Code.

These records are the best means of securing practise in Radio codes at a very small outlay, and I earnestly recommend every student to investigate the merits of these records.—GEORGE HOLMES.

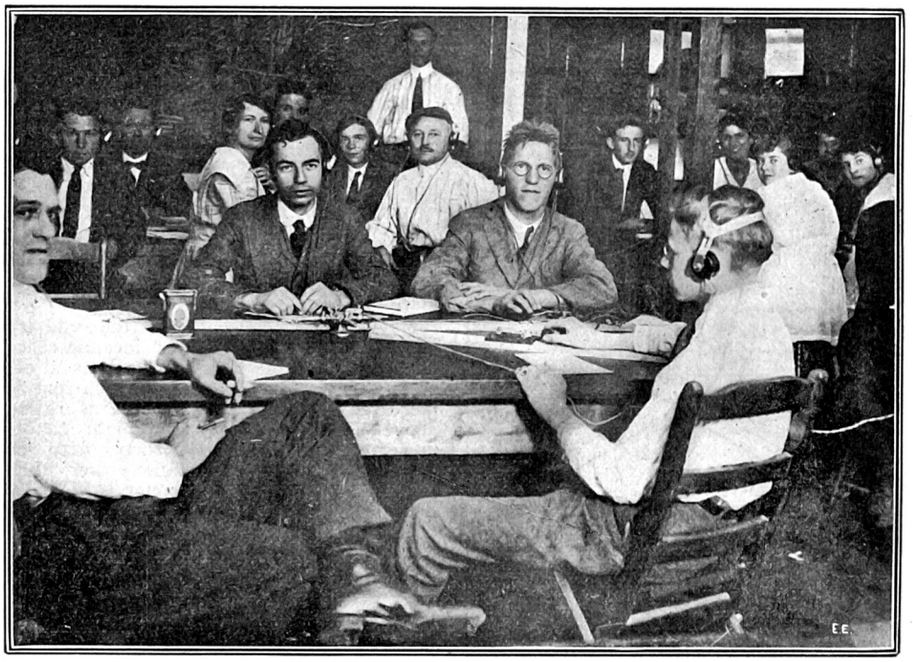
DR. L. W. AUSTIN ON THE AUDION.

Results of observations made on the de Forest-Hudson filament Audion at the United States naval radiotelegraphic laboratory are cited by Dr. L. W. Austin, in the *Journal* of the Washington Academy of Sciences. The gas pressure used in Audion detectors is generally below 0.001 mm. of mercury. By substituting nitrogen for air, to prevent the burning out of the filament, it has been found possible to construct detectors at all pressures up to that of the atmosphere. The action at 3 mm. is entirely normal. Local oscillations are easily produced, and the sensitiveness is fully as great, both for continuous and damped signals, as at the usual pressure. At 10 mm. the sensitiveness is about normal, but local oscillations are more difficult to produce. In the neighborhood of atmospheric pressure no local oscillations have been observed and the sensitiveness to spark signals is much less than at the low pressures. The conditions in this case would undoubtedly be much improved by bringing the electrodes closer together. Even with the ordinary arrangement of electrodes, the changes in the grid and plate currents due to the incoming waves are similar to those observed in the usual vacuum. With 200 volts, the plate current amounts to 20 or 30 micro-amperes. Data are also given on the effect of the D. C. voltage between grid and filament on grid and plate signals.

WIRELESS SETS ARE LIGHT.

One of the wireless sets, employed by the United States Signal Corps, succeeded in communicating over a distance of 119 miles, from an aeroplane, weighs only 60 pounds. Another set, developed at North Island, San Diego, Cal., weighs about 45 pounds, and it has covered a distance of more than 150 miles, while flying at an elevation of 700 feet.

Some of these light weight aeroplane radio transmitting sets utilize a buzzer and "kick" coil, such as featured by Dubelier.



The Wireless Class Maintained by the South Jersey Radio Association at the High School in Collingswood, N. J. This Is What Every Radio Club and Association Should Do to Help Their Country.

NEW JERSEY RADIO ASSOCIATION TO TEACH WIRELESS CLASS.

The South Jersey Association Radio Class opened in the High School at Collingswood, N. J., recently with a large number joining the wireless telegraphy class, including seventeen persons who were not members of the association. Harry W. Densham, secretary of the association, is the permanent instructor and gave the first lesson in radio experiments and wireless telegraphy at this meeting. Several women joined the class and it is expected that nearly one hundred will become members. Those who desire to register and for information 'phone or write H. W. Densham, 410 Woodlawn avenue, and C. Waldo Batchelor, president, 207 Woodlawn terrace. Mr. Densham gives his services and instruction free as "his bit" for Uncle Sam.

BIG RADIO PLANT PUT UP AT CAMP DEVENS.

A portable wireless station, said to be the most powerful in the country, is being set up at Camp Devens, Ayer, Mass., and completed, as a monument to the zeal and patriotism of a group of college men, scions of wealthy families.

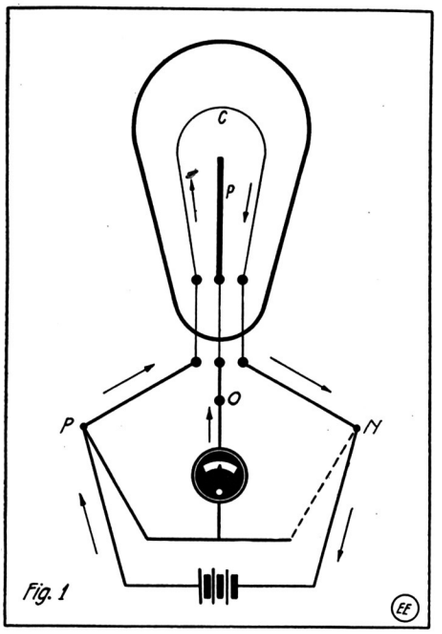
Capt. J. J. Fanning is the skipper of this crew of signal corps experts, crack radio and telegraph operators, mechanics and electricians, who bear the label of 301st Field Signal Battalion, Reserve Corps.

Departmental red tape having interfered with the furnishing of their equipment, they bought their own, and have erected a pole 70 feet high on which the antenna will be spread to intercept messages from Panama, London and other places, and also German messages.

The Audion and The "Edison Effect"

By GEORGE HOLMES

MUCH has been said both pro and con on the Audion of late and considerable litigation has taken place between various claimants for the discovery of same. This naturally has set our vast numbers of amateur and professional



The Simplest Form of "Edison Valve," Having a Platinum Electrode Mounted Between the Legs of the Filament. When the C. P. Was Raised a Current Was Found to Flow Thru the Galvanometer.

radio men wondering where to secure their Audion apparatus and as to what will develop that will place this instrument on the market again or some substitute equally as efficient.

De Forest and Fleming both have certain claims, it is true, altho it has been shown that both their types of bulbs are used differently and achieve excellent results; especially is this true of the Audion.

At a recent meeting of the *Institute of Radio Engineers* at New York, the why and wherefore of the Audion was thoroly discust and the fact presented that the same could be used as an *oscillator* and *amplifier,* whereas with the Fleming valve, it was impossible to do this.

Then again there is a call from Mr. Meadowcroft, Edison's associate, to the technical press, to the effect that Mr. Edison has first place as the inventor of the principle from which was derived the present day *valve,* Audion and other hybrid forms of vacuum bulb detectors.

Looking up the history of the subject, the writer succeeded in locating the fact that in a paper presented before the first meeting of the Institute of Electrical Engineers, way back in 1884, there was shown the principle of the valve as discovered by Edison, and bulbs containing *third members* (electrodes) were displayed.

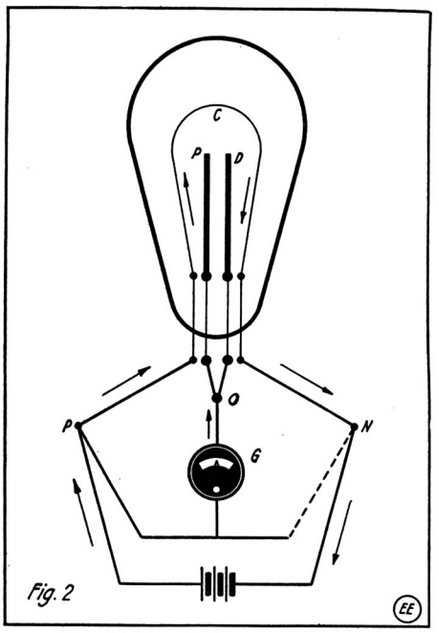
Due credit must be given to Edison for his practical improvements of the incandescent lamp and it seems that while experimenting on this device with various elements that the following phenomena were noticed and recorded.

It is not my object or purpose to make any certain claims, only to give the readers a light on a very obscure point as to the first discovery of the principles of the vacuum valve. Later, with certain improvements and different forms of elements the present day valve was brought out, but it seems that Mr .Edison should receive credit for it in some way, altho he probably had no conception at that time of the application his principle would be put to.

Referring to Fig. 1, a platinum strip or plate (P) will be seen supported between the two branches of the usual looped filament. The posts P and N are connected to the ends of the carbon loop, and O to one end of the platinum plate; P is the positive and N the negative terminal of the electric source. The lamp is placed in the circuit of an electrical source or battery; the current will then flow as per arrows. The galvanometer G, has one of its terminals connected with the positive terminal P and the other with the platinum plate.

Now, it was proved that if the ordinary current used in producing incandescence is passing thru the filament, no unusual effects were noticed. But if the current is increased, so that incandescence is raised above normal, for instance eight candle power to twenty, thirty, forty, fifty, or perhaps one hundred candle power, then the needle of the galvanometer is violently deflected by a current passing thru its coils.

When the connections were reversed, that is to say the galvanometer terminal



A Similar "Edison Valve" to Fig. 1, Excepting That Two Auxiliary Platinum Plates Are Used. Galvanometer Deflections Were Also Obtained With This Arrangement.

from P to N terminal as per dotted line, then a current of negative polarity flowed, but greatly reduced, or about one fortieth of the previous flow.

It was thought at the time that a Crookes' discharge from one of the poles might produce an electrical bombardment against the plate, each molecule taking a small charge that might produce the effect of a current.

Such being the case, if we conceive a flow of molecules passing from the platinum electrode to the heated carbon, then the phenomenon may readily be explained as a *Crookes' effect,* since we can regard a current flowing in a parallel circuit, from P to N thru the carbon loop and from P thru G, O and P to the carbon loop. But remembering that the direction of the current is reversed or apparently so, then when the galvanometer is connected to the negative terminal N, the difficulty is to understand how the current there produced could possibly overcome the current from the source supplying the lamp. It was also noticed that the deflection of the galvanometer needle was quite feeble when connected to the negative terminal.

In Fig. 2, we have another lamp whose parts are the same as in Fig. 1 only two platinum strips, PD, placed parallel to each other are incorporated. Prof. Edwin J. Houston at that time said that if a current is produced when terminals, O, are connected to the galvanometer, then the phenomena is still more difficult of explanation, but he believed that one pole of the electrical source or power is always connected with the galvanometer, the other being connected with either or both of the platinum plates; such being the case the phenomena would simply be a modification of the action in bulb shown in Fig. 1.

He also believed that in some way the molecular bombardments against the platinum plate produced an electrical current; such being true, then if terminal N, is connected with the galvanometer, the current would flow thru the galvanometer in an opposite direction to the current from the electrical source, rendering the previous idea untenable, owing to the fact that the phenomena could not be described as a *Crookes' effect.*

But if we suppose this opposite current out of the way, then it may show the sufficiency of the Crookes' effect as an explanation of the phenomena. This was illustrated by further experiments performed by Mr. Edison, which threw no little light on the matter. Referring to Fig. 3, instead of placing the platinum pole, P, inside the carbon loop, it was placed at the end of a long tube T, this tube forming a part of the lamp chamber. When connections were made, as shown, with the platinum plate at P, so as to place it in line with the carbon, and therefore expose the filament to the bombardment of the molecules shot out from the charged platinum disc, the needle of the galvanometer was deflected, even tho the tube T was surrounded by a freezing mixture. However, when the platinum plate was placed at P^1, in the branch tube, out of

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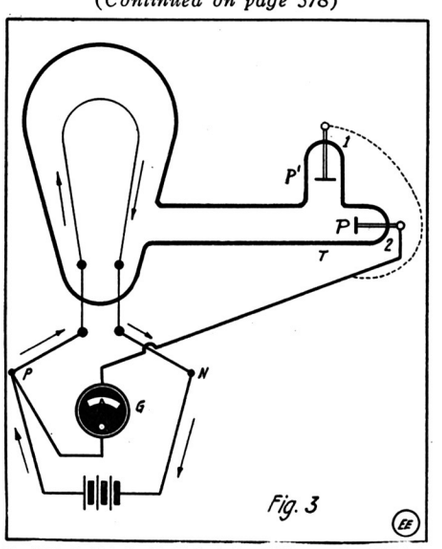


Modified "Valve" Tried by Edison, In Which the Auxiliary Electrode "P" Was Mounted at the End of an Extended Chamber "T." Distinct Galvanometer Deflections Were Easily Obtained With This Device.

The How and Why of Radio Apparatus

No. 5—Radio Transmitting Inductances.

From time to time we will describe one particular instrument used in either the radio transmitting or receiving set, explaining just how it works, and why. We have received so many requests from new readers asking for such explanations, that we have decided to publish this matter in serial form. In the course of several issues all of the principal transmitting and receiving apparatus will have been covered. The subject for the second paper is RADIO TRANSMITTING INDUCTANCES.

RADIO transmitting inductances are of several types. The principal characteristic of this particular piece of apparatus is that it invariably has an "air" core, in contradistinction to the ordinary alternating current inductance, which is most always provided with a laminated iron core.

The difference between these two forms of inductance as just described is due to the fact that the frequency is so high in radio oscillatory circuits that iron cannot be efficiently used for several reasons. There may come a day when we shall have radio inductances with iron cores, but up to the present time it has not been found practicable to provide them, even tho there is a very large loss due to the electro-magnetic induction which has to take place thru air which, as is well-known, is a very poor conductor of magnetism. Iron at radio frequencies and in such circuits as these tends to lag behind the rapidly changing current, and gives a very low power factor, besides producing a high loss due to hysteresis.

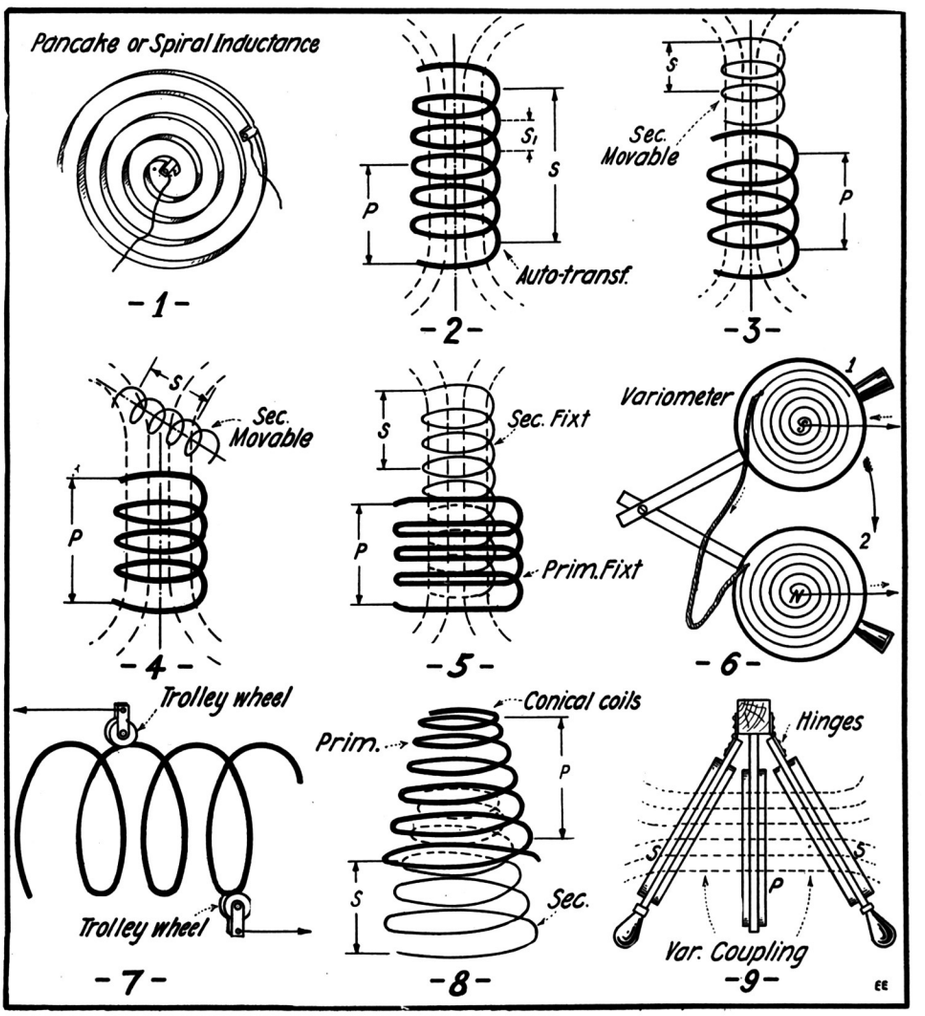
We will take up in this paper several types of tuning inductances used in radio transmitting circuits, and which have been adopted in actual practise. Fig. 1 shows what is known as the "pan-cake" or spiral inductance. This is a very effective form, particularly when wound of flat copper ribbon. It is sometimes built of heavy round wire, but the flat ribbon of course gives the most efficient results. Spring clips are provided with practically all inductance coils of these types, so that any part thereof may be included in the circuits to which they are connected.

The inductance illustrated in Fig. 2, comprises what is known as an *auto-transformer*. In this case a single winding serves as both primary and secondary. The primary circuit being connected across at P, and the secondary circuit connected across the clips at S or Sl, etc. It is possible to vary the coupling between the primary and secondary circuits to some extent with such a transformer, by connecting one of the circuits to the position Sl (*i.e.*, widely separated), for instance, as related to the second circuit at P.

The dotted lines running axially in diagrams here shown indicate the magnetic field set up when current passes thru the coil, and the action of the auto-transformer becomes evident from Fig. 2, as it will be seen that all of the turns in the coil are threaded or cut by magnetic flux created in it. Thus it is possible to increase the potential of a circuit with a single winding as shown. When potentials are to be increased by auto-transformers, the ratio between primary and secondary voltages is usually not greater than 3 to 1 or 8 to 1.

Diagram Fig. 3 shows the simplest form of *loose-coupled* oscillation transformer for transmitting circuits, and which comprises a helix P, into which a smaller coil S, or secondary, may slide. The spark gap circuit is usually connected to the outer coil or across the clips P, while the aerial and ground connections are made to the movable secondary coil S. In any case, the number of turns, or fraction of a turn, in either circuit are adjusted, with a hot-wire ammeter connected in the ground lead, until a maximum radiation current is obtained. Of course, the wave length must be checked on a wave meter, or else computed, but the wave meter method is always preferable. The action of this two-coil oscillation tuning transformer is evident from the illustration Fig. 3, where it is seen that the magnetic flux lines from coil P, cut across the turns of the secondary coil, even tho the thus variable and the amount of inductance in either circuit is adjustable as in other types of transformers; *i.e*, by changing the numbers of active turns in circuit. The position for maximum coupling with this oscillation transformer occurs when the secondary and primary coils are placed in the same axial relation; when the secondary coil is rotated 90 degrees, or in a position at right angles with respect to the primary coil, a position of minimum coupling is obtained. The magnetic flux field is shown by the dotted lines as in the other diagrams.

There is another form of two-coil oscillation tranformer which has been used quite



All of the Principal Types of Radio Transmitting Inductances Are Illustrated Above. The Peculiar Characteristics of Each One Are Explained in the Accompanying Text.

coils are often quite widely separated.

Maximum coupling is obtained when the secondary coil is all the way within the primary coil, and vice versa. A unique type of transmitting inductance having two coils, one for the secondary and one for the primary, is shown at Fig. 4.

This type has found much favor in commercial radio circles, and works very efficiently when it is properly related to, and designed for use with a certain type and size transmitting set. The primary coil which is usually the larger one is shown at P, while S, or the secondary coil, is rotatably mounted in a fixt axial position above the primary. The degree of coupling is extensively in commercial radio work as well as in experimental and amateur stations, and this is illustrated at Fig. 5.

Here the secondary as well as the primary windings are fixt and mounted upon a stationary frame. Considerable variation in the coupling can be obtained by causing the secondary active turns to be at the upper end of the fixt secondary winding, while the active primary turns are caused to be at the lower end of the fixt primary winding, and vice versa.

One of the easiest ways of making a two-coil oscillation transformer is based upon this principle, and necessitates the cutting

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Efficient Dry Battery Service for Audions

By RALPH BATCHER

NOTWITHSTANDING the progress made in storage battery construction in recent years still the uses for dry batteries are increasing as never before.

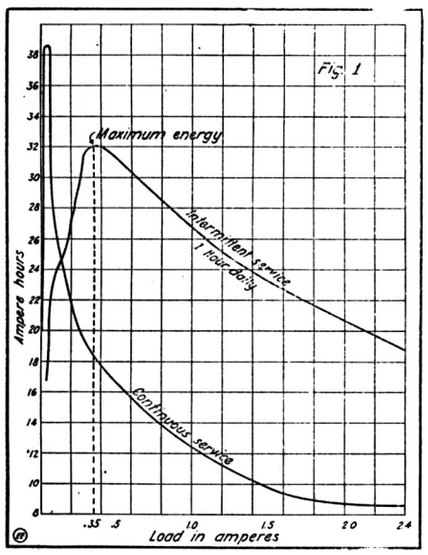


Fig. 1. Graphic Curve Showing the Energy That Can Be Obtained From a Dry Cell with Various Discharge Rates. The Maximum Ampere-Hours Output Was Obtained with a Load of .35 Ampere, as Will Be Observed.

Since the advent of the "Radio vacation" all amateurs who are really experimenters have been planning improvements for their stations when the day should come when the "lid" was removed. Those who have not used an Audion are planning a way to procure this important piece of apparatus. But with an Audion a storage battery is necessary, they are told. But since all amateurs have not access to charging facilities they must use dry batteries.

The question now remains to find out if dry batteries can be used with any degree of efficiency, and if so how they should be connected.

A tubular Audion bulb has a resistance [hot] of about 4.25 ohms. This value is the average of several bulbs burned at about normal brilliancy. Such a bulb takes from .9 to 1.1 amperes (generally nearer the former value). From Ohm's Law (voltage equals amperes multiplied by ohms resistance) we find that it will take from 4 to 4.5 volts imprest on the filament to furnish this amount of current. A dry cell gives 1.5 volts so at least three cells in series will be required. It may be necessary to use a rheostat with a lower resistance and finer variations than the one generally used, if but three cells are used. With this arrangement but very little current would be lost in the rheostat resistance itself.

Referring to Fig. 1 a curve is given showing the energy that can be obtained from a dry cell with various discharge rates. The curves are plotted from data furnished by the National Carbon Co., obtained with ordinary batteries. In the computation of the life of a cell, the time was taken until the voltage dropt to .8 volt.

It will be seen that for intermittent use of 1 hour daily, that the greatest number of ampere-hours are obtained when .35 ampere is taken from a cell. Thus three cells must be used in parallel if 1 ampere is to be used to give efficient dry cell service. The battery must contain nine cells connected in series-parallel to give the 4.5 volts and 1 ampere. The combination will give a little over 325 watt-hours of energy. It will be necessary in time to either add another cell to each series set, or reconnect them so that four cells are in series to maintain sufficient voltage to operate the bulb.

There is another idea that can be followed up when it is desired to furnish the greatest amount of energy to an external circuit with the minimum consumption of current, from the dry cells.

Ohm's Law states

1. $I = \frac{E}{R}$, where I equals the current in the circuit, E the voltage, and R the total resistance.

The electrical expression for energy is

$$P = RI^2$$

Therefore, since $I^2 = \frac{E^2}{R^2}$ $P = RI^2 = \frac{E^2R}{R^2}$

R is equal to the total resistance of the circuit, which in the case of a circuit using dry batteries, is equal to the sum of the external resistance (load) and the internal resistance of the cell or cells. (It should be remembered that the internal resistance of cells in series adds up, while the resistance of cells in multiple follows the reciprocal law) which we will call R and r respectively, as in Fig. 2.

Then $P = \frac{E^2 R}{(R+r)^2}$

Now what value of R can be found so that the useful energy in the circuit is at a maximum with the smallest amount of current, this is: RI^2 is greatest for the smallest value of I. This value can be found

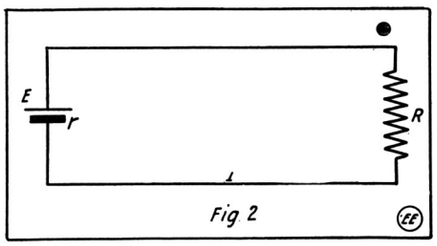


Fig. 2. To Obtain the Greatest Value of Energy In a Circuit the "External Resistance" Must Be Equal to the "Internal Resistance" of the Battery. That Is R = r.

by a simple application of differential calculus.

Differentiating Eq. 3,

$$\frac{dP}{dR} = \frac{-2E^2R+E^2(R+r)}{(R+r)^3} = \frac{-2E^2R+E^2R+E^2r}{(R+r)^3} = \frac{E^2(r-R)}{(R+r)^3} = 0$$

Solving the above equation for the real roots gives for the maximum value

$r - R = 0$ or $R = r$

The same thing can be shown in a rough way by substituting values for R and finding the value RI^2 in each case.

Therefore to obtain the greatest value of energy in a circuit the "external resistance" must be equal to the "internal resistance" of the cells.

RUSSIAN SOLDIERS AMAZED AT WIRELESS.

An interesting description is given by a Russian officer of one of the numerous little mobile field wireless outfits operating near the front. The whole wireless station can be unloaded from its auto truck, rigged up, and be ready for work in twenty minutes. The seventy-foot masts are hollow and made in sections, which are screwed together when taken off the truck.

The simple peasant soldiers, many of whom come from remote villages where wireless has never been heard of, are greatly fascinated by the station, and like to stand around when they can get a chance and watch the flashing of the spark and listen to its song. "It sounds like butter in a frying pan," they say. They have coined a nickname for the men in the wireless crew, which, as near as possible in English, is "sparkers" or "the spark men."

HOW TO OPERATE AUDION ON 110 VOLTS D. C.

By Norman A. Woodcock.

(De Forest Radio Telephone and Telegraph Co.)

In a recent article in the ELECTRICAL EXPERIMENTER, by R. F. Yates, the question was asked as to why the use of a high potential battery could not be dispensed with in the plate circuit of an Audion. Whilst at the present stage of development, a high potential is absolutely necessary between the plate and filament, there is no longer any reason why batteries should be used for this purpose.

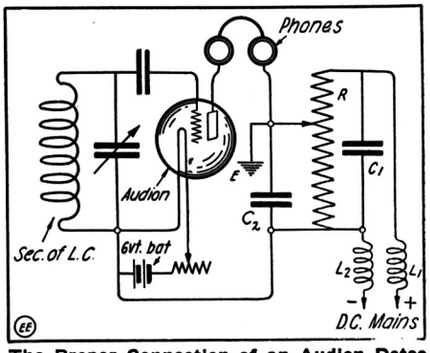
Thanks to a recent invention due to Dr. Lee de Forest, a means has been developed whereby the ordinary 110 volt, D. C. supply can be utilized instead of the expensive and cumbersome flashlight batteries generally employed.

The circuit shown in the accompanying diagram is simple, and could readily be made up by any amateur experimenter possessing a little ingenuity. To avoid mistakes, the entire Audion hook-up is shown. This is standard, with the exception that the high voltage battery in the plate circuit is replaced by the arrangement now to be described.

The ordinary 110 volt D. C. mains are connected thru a pair of choke coils L_1L_2, to the terminals of a condenser C_1. These choke coils may be composed of fine insulated wire wound upon iron cores, whilst the condenser may be of 1 or 2 m.f. capacity.

R represents a high resistance potentiometer having a sliding contact as indicated. The resistance should range from about 5000 to 25,000 ohms. A grafite rod will serve the purpose admirably.

The remaining condenser C_2 may be of 1 m.f. capacity, whilst the circuit may be grounded as shown at E or not, as found advisable by experiment. Suitable condensers may be purchased from any electrical supply house, as they are in common use in telephone practise. When the circuit is properly adjusted, there should be practically no noise heard in the telephones. If this is not the case at first, a few trial adjustments will usually give the desired result.



The Proper Connection of an Audion Detector to a Direct Current Lighting Circuit, to Eliminate the "B" Battery. The Latest Audion Sets Operate In This Way.

It should be hardly necessary to add that the above arrangement *will not work* on Alternating Current.

THE CONSTRUCTOR

The Uncrowning of the Gimcrack King

By THOMAS REED

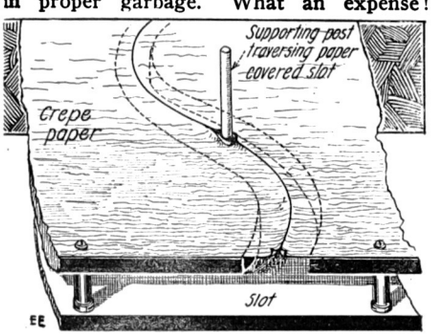
DID you ever have a large, fat fortune come and stare you in the face, hold out its hand in the most enticing way, and then suddenly turn its back on you and beat it? I did. It came about thru my advertising novelty, the "Sailing Boat."

In my early days, the only advertising novelty was to advertise at all. If you were going to all the trouble of running a store to sell thread and buttons and hoop-skirts, the public surely ought to reciprocate by giving you their trade. They had to, anyway, if yours was the only place in town. You didn't need to tell them where to go; and to tease them into buying when they didn't really need to would have been wicked.

Advertising was resorted to only as a simple home remedy for an attack of competition. Suppose some mercantile pirate, without regard for God or man, opened up a store next door to yours, with a line of buttons that the women—the crazy things!—liked better than the ones the drummer stung you on three years ago, and commenced swiping your trade. Well, when you'd become sufficiently scared, and your wife was going strong on how she'd always told you so but you wouldn't listen to her and what was going to become of the happy home now, you sought the village editor and paid him seventy-five cents for an advertisement in his paper, something like this:

H. GREEN
Dry Goods.
14 Main Street

No pictures of women in the corset-stage of plumage—mercy sakes!—or offers to sell goods for less than they cost you—what were you in business for, anyway? No, merely a dignified reminder that the public was—no doubt inadvertently—straying from the only legitimate joint in which to garb itself in proper garbage. What an expense!



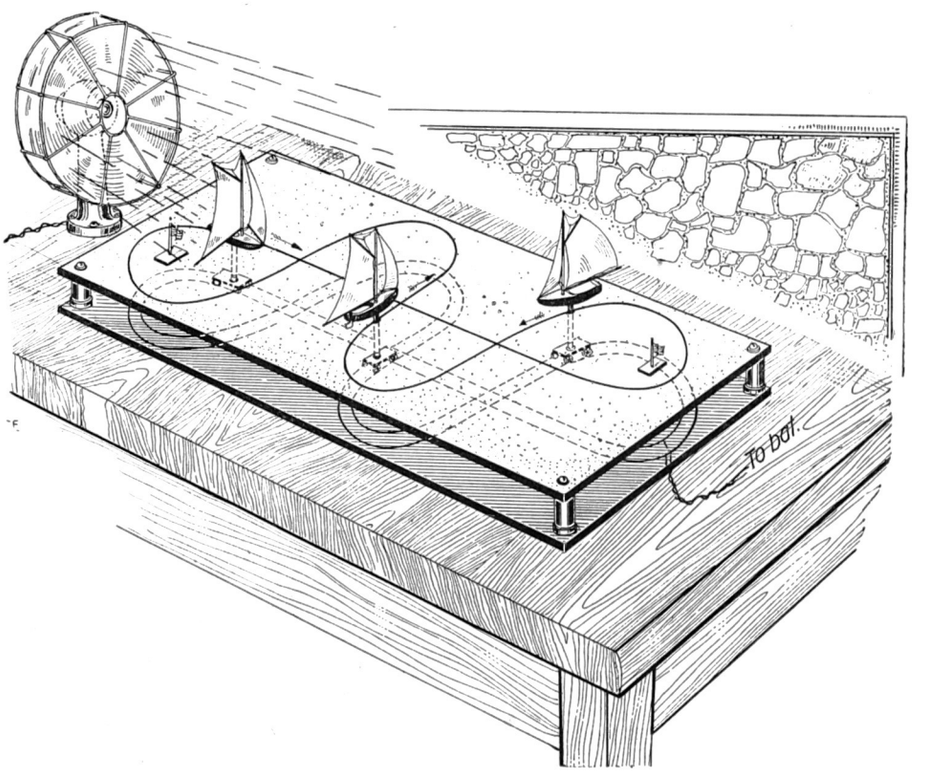
Detail of Crepe Paper "Water" and Method of Covering Slot So That Post Supporting Boat Would Not Leave Slot Open.

Seventy-five cents just for that, when you knew the editor used the same type over again for something else, so it didn't cost him anything. However, it had to be done; and now you hoped to goodness your trouble with that competitor was at an end. Such was advertising before it began to be spelled with a large, bold face capital "A."

I remember well when the capital "A" first came within my ken. Uncle George had been to New York, and one evening he dropt in and told us about it. Things had got to an awful pass there, he said. Quantities of stores kept the very same articles, and the only way to get any trade at all, or even keep what you had, was to *advertise*. Some people did it every little while. It was a terrible expense, and ate into your profits like anything.

Well, he told of the various things they did to catch people's attention, and I was dozing off because it was kind of warm in the sitting-room, when I sat up with a start, for he was talking about certain motion-novelties, animated "figgers" in the windows, that folks stopt to look at. Any silly contraption would draw a crowd, he said; tho he couldn't see the use of it, because most everybody just looked and past along, and never even went into the store at all. Personally, he wouldn't waste his time looking at such "gimcracks."

There was one exception, tho, on which he had bestowed a moment. It was in the window of a restaurant, and consisted of a miniature of that restaurant itself, just as perfect as could be, with a file of lean



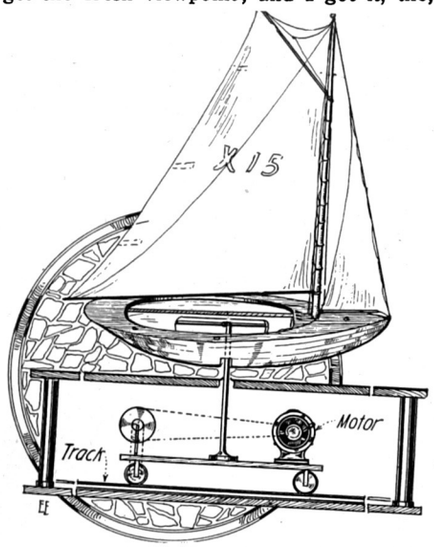
Here's the Boss "Gim-crack"—It Almost Coined Money. The Breeze From the Electric Fan Caused the Sail-boat to Swing Over Realistically As It Rounded the Curves. The Boat Was Propelled on a Miniature Electric Railway Car.

people going in one door, and a file of fat ones coming out another door. "As much as to say they'd eaten a lot inside the place" —explained Uncle George for fear we'd miss the point—"see what I mean?"

If this novelty was the only one Uncle George had favored with his attention, he sure made up for it with his neglect of the others; for he watched its operation so long that he digested his last meal and got hungry again; and this restaurant being so near him, the impulse struck him to be a wild-eyed sport and go in there and dine. The funny thing about it was, he found the dinner first-rate, and cheaper than at his hotel, so he took all the rest of his meals there while he stayed in town. He strongly recommended the place to Father the next time he should go to New York, and gave him a card that he'd asked the proprietor for on purpose, so Father could find it. "But gosh," said Uncle George, "you'd never know the place was any good to look at it—no pies or cake in the window, nothing at all but that fool toy—perfectly useless, and it must have cost a lot, too." According

to him, those New Yorkers didn't know any better than to throw their money away.

They say it takes the new generation to get the fresh viewpoint; and I got it, tho,



Side View of Sail-boat Mounted on Miniature Electric Railway Car. The Car Motor Obtains "Juice" from the Two Insulated Rails, the Axles Being Insulated Also.

of course, I didn't mention it aloud because in those days there was no great demand for younger generations' fresh viewpoints, or freshness of any kind. In spite of Uncle George's disdain, it struck me that if a gimcrack was persuasive enough to wean a man like him from the table of the trusty Broadway Central, sell him a long line of "eats," and send him home a booster, such contrivances must have the merchandising world absolutely by the tail.

Instantly a vast prospect opened to me, of success and wealth in this direction, for gimcracks were decidedly in my line. The only trouble with those which I was always making and imagining was that, tho undoubtedly interesting, they were not of the slightest use. But here was a way to turn the interest into use; and I pictured an endless series of brilliant mechanical devices emanating from my brain like the fat people from Uncle George's restaurant, faring forth to earn me royalties and make me famous as the "Gimcrack King." There was practically nothing to it; in fact, I wisht the thing had been a little more difficult, because some historian in later times, reading of my meteoric rise, might get wise to the fact that it had been nothing but play to me, and so belittle my achievement.

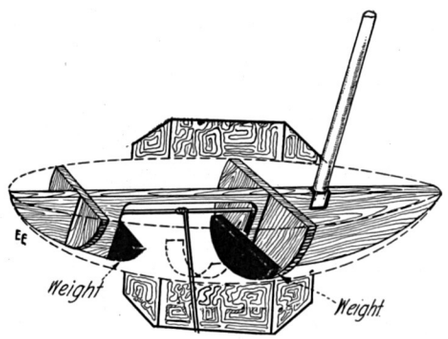
The next day, I was at work on Gimcrack No. 1. I realized I should have to begin in rather a small way, strictly on my private resources. I was averse to borrowing money from Father for the promotion of new enterprises, and he shared my aversion; I may even say that since the clock episode his share was the larger. So, out of the many ideas already in stock, I chose the "Sailing Boat," as the least expensive.

The accompanying illustrations show the principle. The boat, of the lightest possible construction, was mounted on a small truck, rolling on a track, and driven by a toy electric motor "geared down" to produce the slow and stately motion of a floating craft. A slender steel post elevated the boat itself above a wooden flooring, concealing the tracks and motor-truck, and covered with blue crepe paper to represent the sea; the paper being continued over the edges of the narrow crack thru which the post ran, meeting at the middle and parting and reuniting on the passage of the post, so that the surface appeared unbroken.

The boat, balanced lengthwise on pivots and weighted at the bottom, heeled over with a natural slant to *starboard* and *port* as she "beat to windward" against the breeze from a concealed electric fan. Rounding the weather buoy, she would straighten out and go off "down the wind" to the other end of the ocean floor, when she would luff majestically round the leeward buoy and recommence her tacking.

Elaborating the idea, certain sections of the tracks were insulated and provided with small resistance-coils, so that the boat varied in speed, as tho the wind lulled and freshened. I thought of introducing later a second boat, which should follow the first, sometimes appearing almost to overtake it, but always losing headway at the critical moment—a bid for the sympathy of the large "also-ran" element of the populace; but a single boat was all I was able to finance at the start.

When this rinktum was in operation, the family were invited to a private view. Being obliged to impersonate the electric fan myself, my lung-power gale produced an unusually "wild night on the coast," the good ship Mary Ann careening till she almost (theoretically) capsized while making hardly any progress, then going at a rapid pace without her sails filling at all. This inconsistency being duly explained, the family admired the invention mildly, but toward its wealth-producing function they were cool. Hadn't I heard what Uncle



Phantom View of Sail-boat Showing Disposition of Lead Balance Weights Inside Hull. These Keep the Boat on a Level Keel Normally.

George said? New Yorkers might waste their money on such things, tho even they must learn wisdom pretty soon; certainly no New Englander would think of mutilating his hard-earned profits in that way. I'd find out, they guest. Thus they put the gloom on me, as families always do.

An inventor is never a good promoter; and I was so far from an exception to the rule that I amounted to what you might call a *retro-moter,* or one whose scheme, instead of going forward to profit, goes backward to a point where he's lucky if he can let go of it before it tows him into the Bankruptcy Court; but I didn't know that then. Regarding the demand for the boat as a certainty, I gave careful consideration to the amount of royalty. $50.00 a week occurred to me as a convenient round number. It was worth that, of course; but it would probably be better along the first, until the business was establisht, to charge much less, say $25.00 or even $10.00 tho it would have to be understood that this was a temporary rate for introductory purposes only.

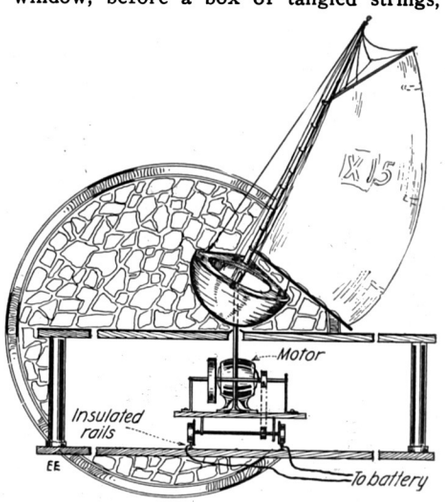
From even the introductory $10.00 rate, I evolved some highly satisfactory figures. The Sailing Boat had cost me, all told, $2.03, so that practically five new ones could be built from each week's profits. At the end of the second week, therefore, my income would be $60.00; at the end of the third week, $360.00; fourth week, $2,220.00; fifth week, $13,320·00; and sixth week, $79,-920.00. I stopt there because the supper-bell rang. It seemed like a lot of money. Perhaps, to be perfectly safe, one had better call it an even $70,000.00; there might be setbacks, of course. Anyhow, when the weekly receipts reached some such figure, it would be safe to divert part of the profits from development, and perhaps purchase one or two articles of luxury.

Now please don't interrupt me while I tell of the disastrous beginning (which was also the end) of my campaign to introduce the Sailing Boat, because I'm much older now and very, very much wiser, and I anticipate your suggestion that instead of tackling the most successful merchant in town, I should have approached the struggling fellow who felt the need of something to stimulate trade. Sure, sure; I know. But as the amounts of money already involved were so large, I felt that the lessee's credit was the first consideration; so, as intimated, I opened negotiations with Zebediah Crowell, whose dry-goods and notion store was the thriftiest thing within the purlieus—Zebediah, while the tightest wad in town, being apparently best equipt to stand the strain of my royalties.

Altho my anticipations of profit were somewhat too intoxicating for a no-license town such as mine, I needed them all to offset the parental scepticism; for father said that no money ever got away from Crowell's grip without suffering internal injuries in the process. So my state of mind might be described as firmness, rather than optimism, as I entered his imposing store, lugging my large package with difficulty, blusht when asked what it was I wisht to purchase, and stammered my desire for a personal interview with the proprietor.

I had nerved myself to the spectacle of Zebediah enthroned in a spacious and luxuriously-fitted private office, and only hoped it would contain a table on which I could make my demonstration with proper effect. Mr. Crowell at that particular moment, however, was said to be in the basement; and bumping with my parcel down a flight of very steep and dark stairs, I came upon the great man engaged in one of the intricacies of trade.

He was seated in the dim light of the only window, before a box of tangled strings,



End View of Boat and Electric Car. The Motor Drives a Counter-shaft So As to Reduce the Speed of the Wheels.

patiently undoing the knots and snarls, sorting the strings into sizes, and tying each

(*Continued on page* 578.)

REMOVING RUST ELECTRICALLY.

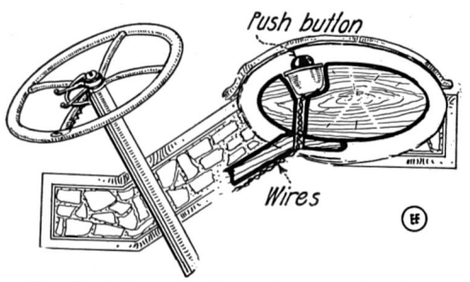
What we call rust on iron or steel is merely a coating formed by the combining of the iron with oxygen, which coating is apt to form in the presence of moisture. Since the obnoxious color of the rust is due to the oxygen in the moisture, any method which will decompose the rust so as to set the oxygen free will leave the bright metal. Now it is well known that when two terminals of an electrical circuit are dipt in water, hydrogen is set free at one of the terminals and oxygen at the other; therefore, what we need to do is to have the rusty metal form the cathode at which the oxygen is given off. Pure water is a poor conductor of electricity, hence one-tenth of its volume of ordinary sulfuric acid should be slowly poured into the water. Adding the acid heats the water and this should be allowed to cool before inserting the terminals, which would consist of the rusty pieces as cathodes and a piece of lead or lead pipe as the anode.

Contributed by PETER J. M. CLUTE.

A CONVENIENT LOCATION FOR AUTO HORN BUTTONS.

Usually when one is driving a car, the horn has to be sounded just when both hands are needed most on the steering wheel, or for some other purpose. The electric horn buttons are located quite desirably on a large number of the new cars; however, there are many older cars, on which it is desirable to install an electric horn, as many people enjoy the charm of a second horn in addition to the one already on their car. In either case the location of the horn button is almost sure to raise a question. A most convenient location for this horn button can be made by boring a half-inch hole in the rim of the steering wheel, as in Fig. 2. In this hole put a small push button, which can be obtained at (any Willys-Overland service station) most electrical supply stores. If the push button is placed a little toward the inside of the rim, the danger of touching it accidentally, will be eliminated. The wires may be run on the under side of a spoke, and down the steering post in the usual way.

As the horn is used mostly at crossings and before rounding curves, the button will always be under the hand which is the least needed for steering at the time, if placed at the lowest point, as shown. For example, if you wish to make a turn at your right, you will naturally pull toward you with your right hand; this will bring the push button a little toward the left, bringing it under the free hand, which will not have to be removed from the wheel to reach the horn button.



The Best Place for the Auto Horn Button Is on the Steering Wheel.

Contributed by
H. CORCELL STUART.

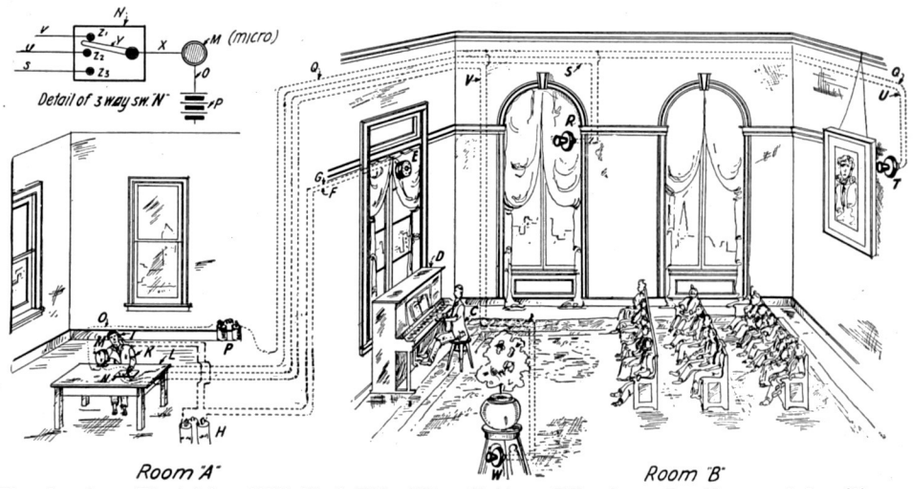
Due to the advent of the war, we are particularly desirous of obtaining snappy manuscripts describing original and practical "Electrical Experiments."

The Mysterious Voice

A Clever Electrical Illusion

By C. A. OLDROYD

THE effect of this electrical illusion is as follows: The performer sits at a piano and plays a tune which has been selected by one in the audience. After he has been playing for a few moments a voice is suddenly heard which sings the very same tune. The voice seems to come from behind the stage, but after a few bars of the song the voice seems to come from a far corner of the room—perhaps from the ceiling.



The Amateur Electrician Will Find This "Stunt" Very Effective. By Means of Sensitive Microphones and Loud-speaking Telephones the Audience Is Induced to Believe That a Real "Mind-reading" Seance Is Taking Place.

While the audience is looking in that direction, trying to discover the mysterious singer, the voice suddenly changes and seems to come now from a third place—the midst of the audience—only to change back again to one of the former points in a jiffy. The explanation of this "stunt" is given below.

Referring to the diagram, we have two rooms, A and B, about twenty yards apart. The performer C, and piano D and the audience are in room, B. A sensitive microphone, E, is concealed behind some curtain or other decorations and two wires, F and G, lead from E to a telephone I in the room A. This telephone is provided with a head band, worn by an assistant, K. A battery H, consisting of a few dry cells is connected in series with the microphone and telephone. The assistant K, sits in front of a table L, to which is secured a sensitive microphone, M, in a convenient position. One binding post of this microphone is connected to a wire O, a battery P, and finally, by means of the wire Q, to loud-speaking telephone receivers, R, T and W.

The other binding post of the microphone M, is connected by a wire X and a three-way switch, N. This switch consists of a wooden base upon which are mounted a lever, Y, and three contacts Z_1, Z_2 and Z_3. Z_1 is connected by a wire V to the loud-speaking 'phone W; Z_2 by U to T and Z_3 by wire S to R.

It is now clear that the assistant can, at will, by means of the three-way switch, N, connect any of the loud-speaking 'phones T, R, or W, to the microphone, M.

The operation of the illustration is carried out as follows:

The performer C, in room B, is asked by a member of the audience to play a certain tune. The assistant K, in room A, hears the music of this tune in his 'phone I. He sings into the microphone, M, and puts the lever Y, of the three-way switch N, into the position Z_1. The current will then pass over the wire V into the loud-talker, W, which is concealed behind let us say a jardinière. After a few moments the assistant changes the position of the switch, N, to say Z_2, and the voice will then be heard coming from the 'phone T, which may be concealed in the midst of the audience or behind a picture.

If the lever Y is changed to position Z_3 the voice will be heard in the loud-talker R, and so on. The placing of the 'phones must be left to the experimenter, but very good places are: in flower-pots, under tables and behind pictures. In every case, care must be taken that the opening of the 'phone horn is not obstructed. With a little care this can be easily provided for, as by having a number of artificial rose bushes or other flowers arranged in two rows and the lane between them leading in a direction down which the audience cannot see.

A NOBLE USE FOR AMATEUR RADIO TRANSMITTERS.

I have thought of a plan to utilize every amateur sending set in the country and help in the saving of life and the success of the war, Simply, it is this:—Let every amateur take his sending set and fix it up to work at the ordinary commercial wave length, and put the outfit, which should be worked off dry cells, in a 5 gallon coal oil tin, securely fastened. The whole is then soldered up absolutely air-tight. The key should be on the outside in a little compartment, with a glass cover, also air tight. The sending terminal may also be in this space. The aerial, about No. 20 copper wire (a single strand) is attached to a folding box kite, the wire being wound on a reel mounted on bearings attached to the set, which is crated or rather protected with wood to withstand knocking about. Now one of these sets with simple instructions and a copy of the code is to be placed in every life boat on the merchant ships leaving American ports. This would avoid some of the dreadful stories of hardship, starvation and death, which reach our ears every now and then.

Contributed by WILLIAM H. GRAY.
Lake Buntzen, B. C., Canada.

An Electrically Played Mandolin

By McCLURE ALBRIGHT

WELL, Bugs, it's time to think about those long winter evenings, so clear out your think-tank and light up your jimmy pipe. This is a real job, fellow experimenters, and a task that will keep you interested right up to the time you are ready to throw in the motor switch and listen to the automatically played mandolin. The ideas here outlined are also applicable to a guitar with some modifications.

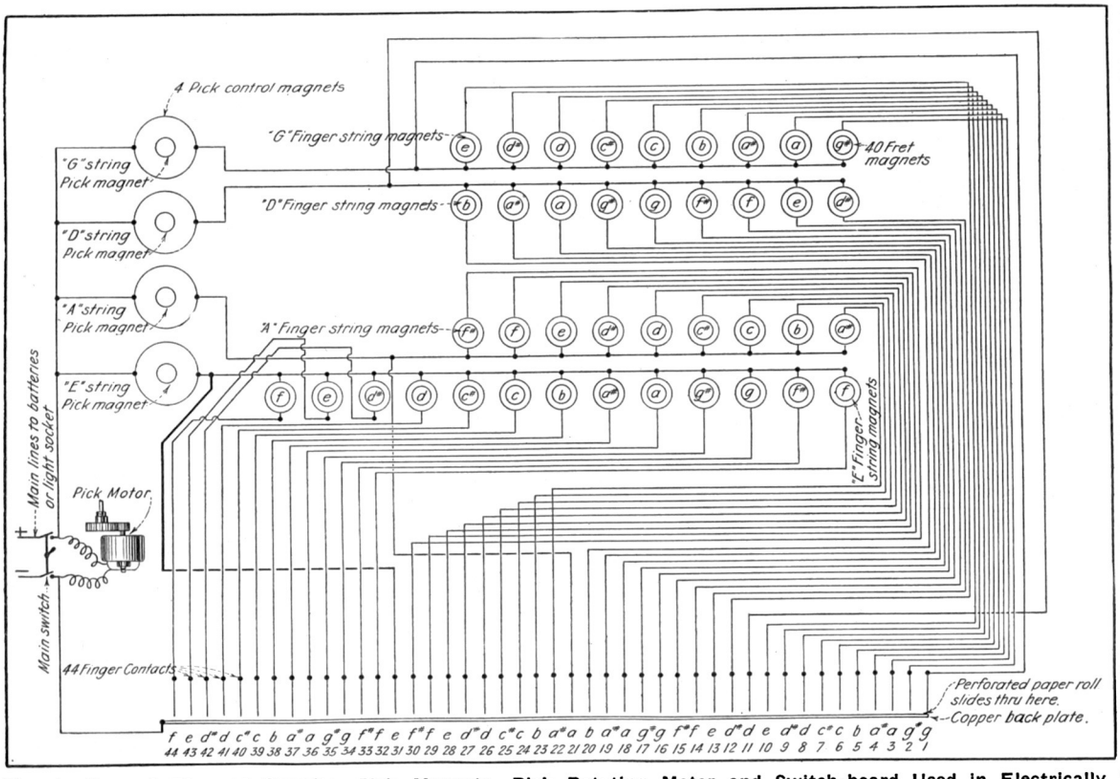


Fig. 1.—General Plan of Circuits, Pick Magnets, Pick Rotating Motor and Switch-board Used in Electrically Played Mandolin. The Same Idea as Here Described Is Also Applicable to a Guitar With a Little Ingenuity. The Details Are Quite Simple.

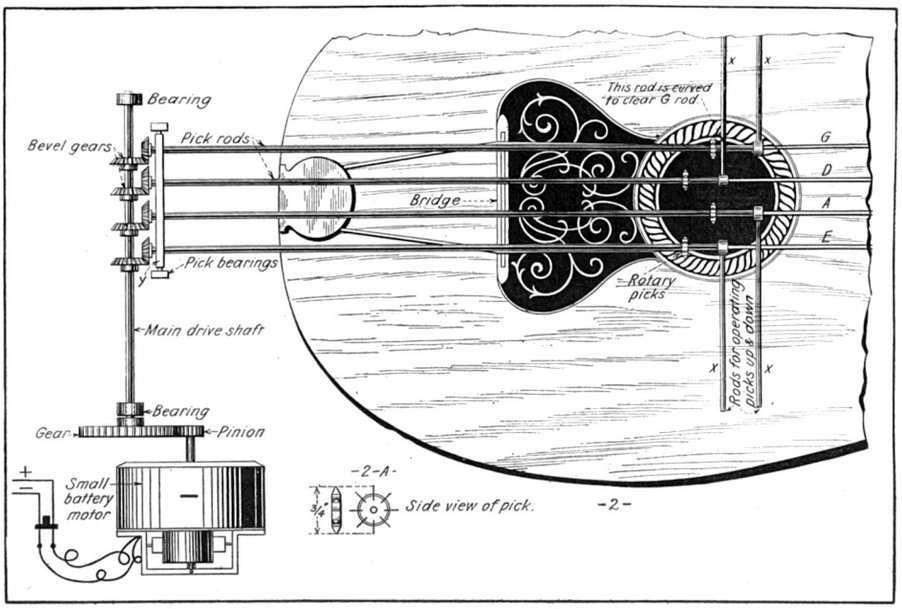
All of the details are not given as most experimenters like to have the pleasure of working out the general arrangement and style of the outfit themselves. The assembly scheme involves a sufficiently large base-board upon which the mandolin will fit, together with various *fret* and *pick* control magnets, as well as the pick-rotating motor.

Referring to Fig. 1, we have a general layout of the fret (finger) and pick control electro-magnets, also the circuit connections to pick driving motor and finger control board. A perforated paper roll is drawn thru the latter, each perforation permitting a contact finger to make contact with the copper plate as shown in detail in Figs. 3 and 1. This part of the work presents a fine chance to learn something about music, if you are not already proficient in that classic.

The wiring can be easily traced out. When an *open* string is to be played, the current passes right thru to the desired pick-magnet only; when any other note is to be played the current passes thru the *fret* (finger) control magnet first and then to the pick magnet. All four strings can be played simultaneously if desired. As an example of the pick and fret magnet action, consider that contact 31 is closed; this causes the pick (constantly rotated by the motor) over the open "E" string to function, giving the note of "E-natural." If contact 32 was closed instead, then the fret (finger position) magnet corresponding to "F-natural" would be actuated, (see detail of this mechanism in Fig. 4); the current passing on thru pick actuating magnet "E," this sounding the note of "F-natural," et cetera. There are 40 fret control magnets, which may be old bell magnets.

Fig. 2 shows the simple manner of arranging the pick rotating motor and gears. The four pick shafts could also be driven by friction wheels and would make less noise. The constantly spinning picks are raised away from or lowered into contact with the strings by virtue of the pivoted suspension shaft Y, and the pick control arms X, X, X, X, attached to four electro-magnets as indicated in Fig. 3-A. The arms X, are normally held above the strings by spiral springs as shown. By means of the stop screw X1, the movement of the pick arm X, may be controlled so as to get the best sound. It must not strike the string too heavily; neither must it sound the string too lightly. A little experiment will soon clear up this point, when the whole arrangement is lined up for final adjustment. The pick control magnet may be a large bell-magnet coil or telegraph sounder magnet. If the builder desires to make his own magnets (four required) they can be built from a wrought iron core ½" in diameter by 2½" long. Fiber spool ends are fastened on the core, these having a diameter of 1⅝". The bobbin is wound full of No. 26 single cotton covered magnet wire, if 6 volt battery current is to be used.

The small motor which drives the pick shafts can be a 6 volt battery type, giving say 1/40 horse-power. The "Little Hustler" motor is too small; those selling at $3.00 to $4.00 are about the right size. It can be either shunt or series wound. One main



Figs. 2 and 2-A.—A Detailed View of the Motor Drive for the Rotary "Picks," With Reduction Gears and Also the Rods for Raising and Lowering the "Picks" Themselves.

switch controls the motor and magnet circuits as becomes evident.

The wiring to the fret magnets, etc., may consist of ordinary bell or fixture wire. It should be fanned out neatly at the terminals and shellacked or tied in place, the same as telephone wires on switchboards.

It will pay to cultivate some musical friends if you are not thoroly familiar with notes, and chords. With a little ingenuity a paper roll perforator can be devised, having a keyboard corresponding to the contact switch-board layout in Fig. 1.

ELECTRIC ARCS UNDER PRESSURE.

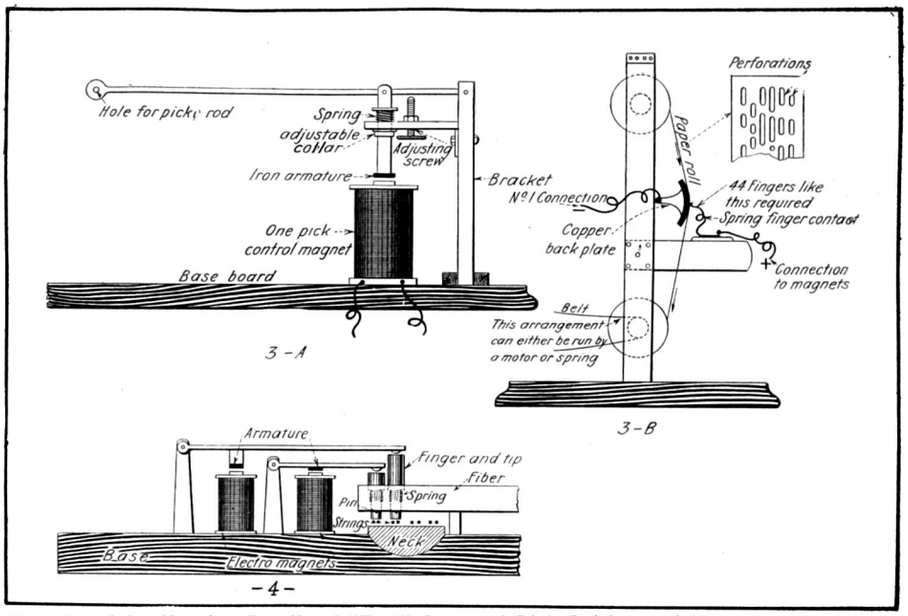
Recent improvements in searchlights have taken the form of various methods of cooling the electrode with a view to obtaining greater local concentration of the light, either by a spray of alcohol or, as in the Sperry searchlight, by a blast of air.

Another line of development being investigated in Germany has been the use of arcs under high atmospheric pressure. Lummer was reported to have obtained promising results shortly after the outbreak of war, and it was thought possible that a considerable improvement in the efficiency of arc lamps and projectors might be secured in this way. According to some experiments described by Mathiesen in the *Elektrotechnische Zeitschrift*, this anticipation is not being realized. Pressures varying from a vacuum up to 5 atmospheres compression were utilized, both with inclined and vertical carbons. In the former case a marked gain in efficiency was secured, but the arc was found to become very unstable for pressures exceeding one atmosphere. On the other hand, with vertical carbons more stable conditions are realized, but the gain in efficiency seems to be very moderate.

A TRACKLESS ELECTRIC CAR.

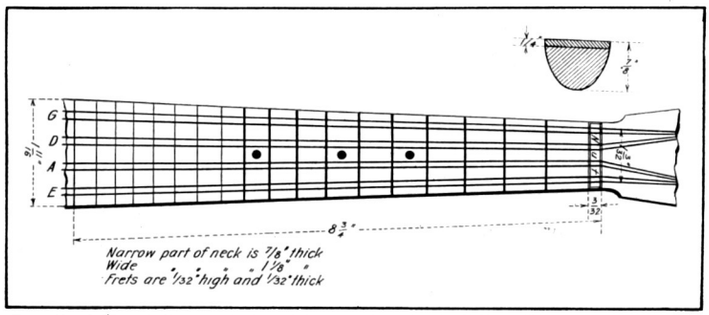
The accompanying illustration shows a very interesting trackless electro-mechanical car or engine, which is operated by current supplied thru the ordinary lamp socket and a step-down transformer. The feed wires drop down from above to the special central pedestal. Thus, there are no wires to interfere with the electrically driven vehicle spinning round and round in a circle on the floor.

The toy may be set to rotate in any size circle, the length of the flexible electric cord being adjustable by means of a small ratchet drum inside the body of the car. This drum has a small handle projecting on the outside of the cab, and by means of the ratchet wheel, the drum remains in whatever position it is turned to.

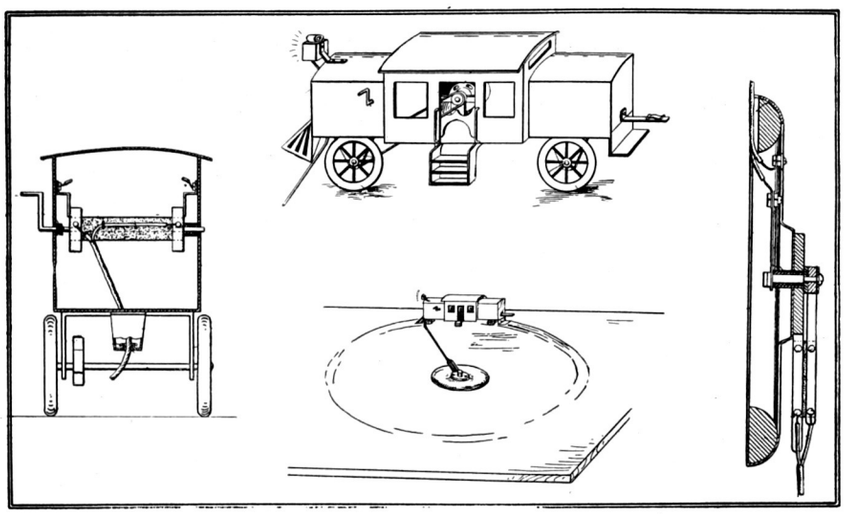


Figs. 3 and 4.—Showing Details of "Fret" Stop and Pick Raising and Lowering Magnets as Well as End View of Switch-board and Sample of Perforated Paper Roll Which Opens and Closes the Circuits.

The two-conductor cable connecting the car with the central pedestal receives its current thru two metal brushes making contact with two oppositely charged rings on the pedestal. A patent on this ingenious toy has been awarded to Walter E. Thayer of Brooklyn, N. Y.



Detail of Mandolin Neck Used by Author in Building Electrically Played Instrument.



A Clever Electric Toy in the Form of a Miniature Engine, Which Runs in a Circle and Without Tracks. Current is Supplied to the Motor from a Central Pedestal.

A MYSTERIOUS PICTURE.

If you are invited to a party and want to amuse the good people, the following trick will keep them guessing for weeks:

Procure a portrait of a member of the party in question, but without his knowledge, of course. Have an enlargement made of the picture, which after being fixt must be thoroly washed. Place it in a solution of mercuric chloride (be careful: poison!) until the image has absolutely disappeared. Wash well again and let dry.

Now you are ready for the party. Fasten your enlargement on an easel such as painters use. From the distance it will appear as a blank sheet of paper. Only very close examination would disclose the fact that the sheet is prepared.

Tell your audience that you have suddenly developed an artistic talent and that you are going to give some proof of your maestria, right now.

Produce your painters brush and a container apparently containing black ink. This liquid is prepared beforehand in the following manner: Fill a glass full of water (about 12 to 15 ounces, to which add two drams of ammonia, take a little India ink and stir it in this mixture so as to make the liquid look black. Be careful not to add too much India ink, so that when brushed on the paper, it will not leave any marks.

Have the members of the party now sit or stand—as required by your portrait—some distance from the easel, and begin to proceed to bring out the picture, by applying the ammonia mixture with your brush. Much to the astonishment of the audience a fine picture appears in a few seconds.

Contributed by

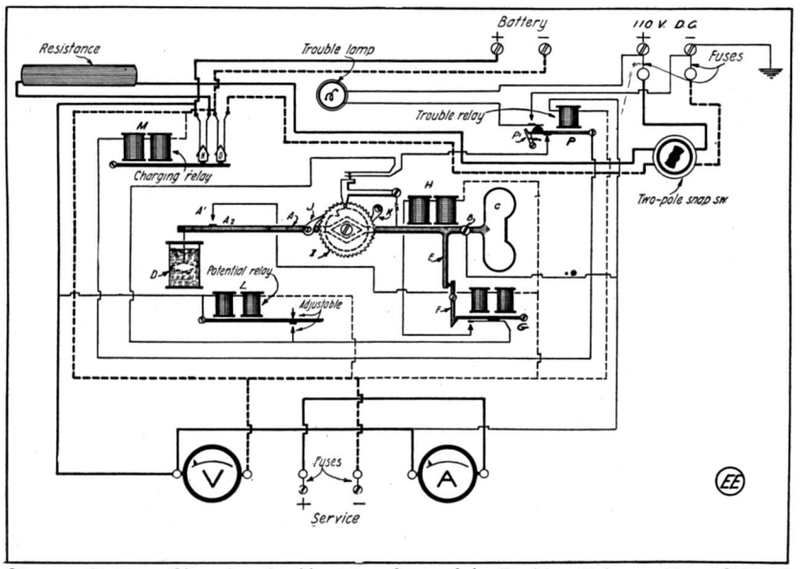
LEONARD VINCHINO.

Due to the advent of the war, we are particularly desirous of obtaining manuscripts describing original and practical "Electrical Experiments." We shall continue to publish Radio articles, but what we need is snappy "Electrical" articles. Be on guard for the enemy—Repetition!

An Automatic Storage Battery Charger

By LEWIS SCRIVEN

AUTOMATIC storage battery charging switchboards are becoming more the general practise wherever this type of battery is used. Its use is significant, and as its name implies automatically keeps the battery in its proper condition at all times,



Storage Battery Charging Is Always a Long Job, Besides Being a Very Critical One. To Charge Them with the Minimum of Trouble and Care, Use Should Be Made of an Automatic Switch-Board Such as That Illustrated.

something which the ordinary person often forgets. The general description which follows will clearly show how such a board operates.

Referring to the diagram: A is a balance bar 15 to 20 inches long, pivoted at B, having a contact point at A 2 to meet A 1; and C a counter weight. D is an oil cup in which a plunger (shown sectionally) is allowed to move freely from side to side; but not loose and is suspended from a light rod from the bar A. By having the rod A, a trifle heavy to counter-balance C, it is allowed to fall slowly by the buoyancy of the oil. Part E is solidly fastened to A, and serves to push F, so as to release armature (which it holds) when A is at its lowest point.

G is a relay having an armature with a contact which catches on the hook of F, when A is up its full height. H is the magnet used to lift A.

I is a cog wheel having a rim about ¼-inch wide with a notch in it as shown by dotted line, and on this rim rests a rod which is used to close contacts. J is a ratchet pawl pivoted on A, which turns this cog wheel on the upward motion, and K a stop-ratchet, so wheel cannot turn backwards.

L is a potential relay, which when the voltage falls, allows its armature to drop, making contact with the point under it, which must be adjustable. The point above, altho not a contact point, must also be adjustable. By having the armature a certain distance from the magnet core it is allowed to drop at the battery's *run-down voltage*. While down it should be such a distance from the core that it will pick up at the *normal voltage*.

M is a charging relay having brass plugs N and O, to close contact springs directly above each.

P is a trouble relay having a contact on its armature which breaks when it is up, but closes other contacts to light a lamp. The armature when up, is retained by catch P 1. (The charging source is presumed to be 110 volts direct current.)

Referring to the electrical wiring the operation is as follows:—Suppose the battery is fully charged; relay L armature will be up. All contacts on the cog-wheel will be open, relay M armature down, and relay P armature down. Since A will have fallen to its lowest point, relay G armature will be down, making contact.

The voltage falls. Immediately the relay L falls, closing two of the contacts on the cog-wheel, energizing coils H, lifting A so that A 1 and A 2 meet. This energizes the coils of relay G, breaking the energy in relay H, and A having nothing to hold it up, begins to slowly drop. Meanwhile ratchet pawl J has turned the cog-wheel enough to close all contacts on it, which energizes relay M, sending the charging current thru the battery; the intervals of time between the contacts at A 1 and A 2 should be about one or two minutes. The arm A will now work up and down until the contacts are again opened by the notch in the cog-wheel. As the diagram here shows it, the bar A is in the act of falling but has not yet released the armature of relay G.

Relay M should not take more than ¼ ampere.
Relay P should not take more than 1/25 ampere.
Relay G should not take more than ¼ ampere.
Relay L should not take more than 1/25 ampere.
Magnet H should not take more than ⅝ ampere.

The trouble relay P is a necessity. Its armature is heavily adjusted so that it takes, say about fifty volts to lift it. Should the battery become disconnected while charging, the high voltage will immediately lift the armature, being held by catch P 1, opening cog-wheel contacts which cuts off relay M, and lights lamp to indicate trouble. This prevents high voltage passing over the battery wires. Attention is also called to the fact that the negative charging source is grounded. Should the negative service wire become grounded, no harm will be done. Should positive service wire become grounded (causing a short-circuit) its fuse will blow. Otherwise, if the positive charging source had been grounded and negative service become grounded, the battery would discharge thru the resistance.

This board can be made to operate on any size battery, by winding the coils to suit, altho 24 volt batteries seem to be standard for low-tension work.

The resistance could also be a bank of lamps, its resistance depending upon the charging rate of the battery. (Eight hours is the standard rate for charging lead plate cells.)

These boards are used in some of the finest buildings and while only one type is here described, any number of batteries can be controlled by one board by a few minor changes and extra relays to care for the different sets.

HOW TO PHOTOGRAPH LIGHTNING.

Don't use films, but use low speed thickly coated plates. The camera should be firmly posted on a window sill, and focused for infinity. Of course the shutter should be open. Watch the storm and as soon as lightning occurs close the shutter again.

It requires quite a lot of experiments to get a good forked flash. Some time a good picture may be spoiled by sheet lightning occurring just a few seconds after the exposure.

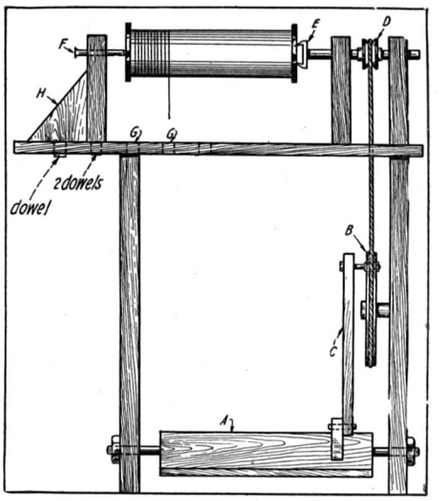
Quick handling is necessary for good results. Develop plates fully, using a contrast-giving developer.

Contributed by JOS. MINDER.

COIL WINDING MACHINE FOR AMATEURS.

The accompanying illustration shows a view of an efficient coil winding machine. It should be made to any convenient size. The treadle (A) is connected to a large pulley wheel (B) by a rod (C) as shown. This runs a smaller wheel (D) which is fastened to an axle by a set-screw. A set of pins (E) are also fastened to the inside end of the axle. At the other side a pivot is made of a long wood screw. The upright which holds the pivot is made movable and may be put in different holes (G) according to the coil to be wound. (H) is a brace for the movable upright. With the aid of this machine one may wind a coil very rapidly.

Contributed by THEODORE LAUER.

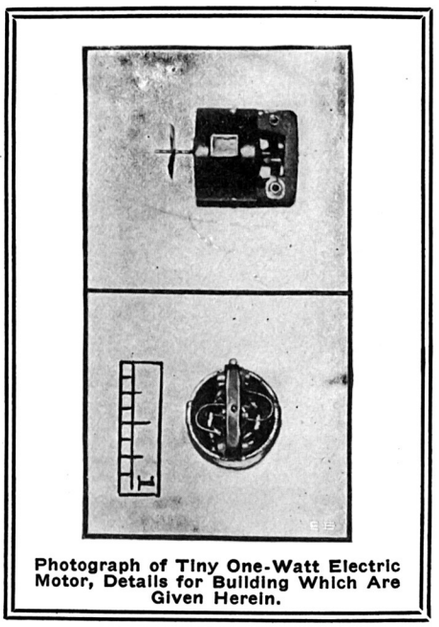


A Practical Winding Lathe for the Amateur Electrician. The Rear Pedestal Is Movable and Is Secured in Various Positions by Means of Dowels.

How to Build A One-Watt Motor

By W. J. HOWELL

FROM time to time publications contain pictures of small electric motors and a short description of how many "fly-power" the motor is able to deliver. Most of the articles state that said motor is very small in size and that jewelers' tools were used to make it, but all these failed to convince me that fine tools were needed and if the



Photograph of Tiny One-Watt Electric Motor, Details for Building Which Are Given Herein.

list given below is studied it will be seen that the tools that were used are those that every experimenter has or ought to have in his work-shop. The list is as follows; shears, drills and drill holder, small vise, three cornered file with one-eighth inch sides and a half inch flat file, small fret saw using fine saw blades, pair of tweezers and a needle holder, which is a small bar with a hole in the end for holding a needle which can be used for prying in small spaces, pair of pliers, with pointed tips and a small soldering iron made from a piece of brass, half inch by one quarter round, and mounted on a piece of iron wire stuck into a wooden handle.

The motor itself is not the smallest thing in captivity but is just about small enough to be easy to make and handle and there is no danger in showing it to other people and fearing that they will *lose it under their finger nail.* I am of the opinion that it is possible to make one even smaller just thru my experience in overcoming construction details with this one, but that is something that can be tried by those who will and have the time to work at the task, for task it is—altho patience is half the battle and believe me, one needs it in large quantities besides a fair ability to handle tools.

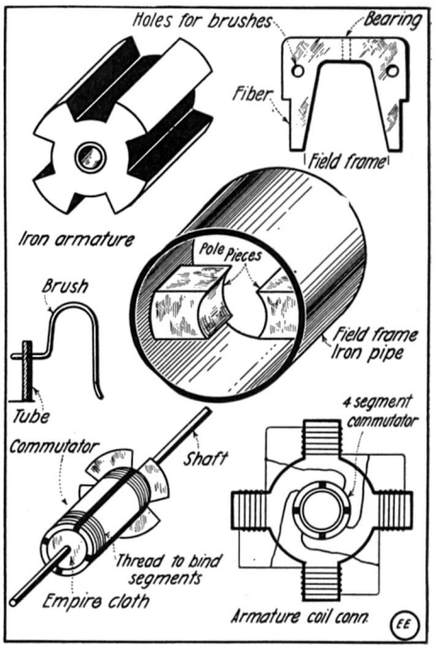
The shaft is made of a piece of iron wire about the size of a number 22 copper wire and is one and one-eighth inches over all. The next thing to build is the commutator; this is made of brass tube one-quarter inch long, altho the actual bearing surface is about two-thirds of this length. The tube should just be large enough to pass over the shaft and still leave room for some insulating material such as one layer of Empire cloth. The tube I used is a trifle over one-sixteenth inch in diameter with very thin walls. Before cutting off the piece for the commutator, saw it with two cuts into four parts or segments, making the cuts about one quarter inch long. Clean the inside surface of the tube and free it from all burrs left by the saw and force it over the shaft, not forgetting to put on the Empire cloth to insulate it from the shaft. Tie the four free ends of the tube down by a thread wound several times around it, about an eighth of an inch from the end, and bend these ends up so that the armature wires can be soldered to them. Then saw off the rest of the tube and tie those four ends down. This construction gives a commutator that is round and each segment is insulated from the shaft and from each other.

The armature is made of five iron washers, three-eighths inch diameter, and as the holes in the washers are too large for the shaft the difference can be taken up by putting on several layers of Empire cloth and the washers forced on until they are about an eighth of an inch from the four bent ends of the commutator. Divide the end washer into eight parts and make a saw cut at each mark until the saw reaches a point midway between the out-side and in-side diameters of the washers. This is done to all five at the same time by holding in a vise. When finished, file away four alternate pieces of iron and this will leave four poles, around which the armature coils (of which there are four) will be wound. Be careful to remove all rough places and then put on a shellac coating over the washers thick enough to act as an insulator, because there will not be very much room for any paper insulation of any kind. Wind each coil when the shellac is dry, with 36 silk covered copper wire, taking care on the first layers not to cut thru the shellac. When finished, the four poles will have four coils which take up most of the room in the slots between them, and the ends of the coils are connected to the starting ones of the next coil; that is, the beginning of one coil is connected to the ending of the adjacent coil and the beginning of that coil to the ending of the next coil, and so on, until the entire four coils are connected in series. It is of course understood that all the coils are wound in the same direction, so that by following the above system of connection, they will be hooked up in the proper manner. Now turn the commutator so that the bent up tips come midway between the iron poles and solder the wires to the tips. This is best done by putting a little flux on the tip and pass the two wires which are twisted together, over the tip and hold the surplus wire down the other side of the armature with the fore-finger, heating the small soldering iron in a Bunsen flame with the other hand, which when hot enough and properly tinned will pick up a drop of solder and held to the tip, thereby securing the wire to it. The surplus wire is of course cut off.

It is best while winding the four coils to test for grounds to the washers and then unwinding and rewinding carefully so as not to cut thru the shellac. With care the armature should be in the class that gives no trouble. Paper could be put on for insulation but it requires a lot of extra time and shellac is alright, if handled properly.

Next in line comes the field-frame work and this is made of an iron pipe three quarters inch diameter and one-half inch long. It is about one thirty-second of an inch in thickness. At one point drill a hole about three-sixteenths inch in diameter and carry the hole straight thru the other side, care being taken that it divides the pipe into equal parts or halves. These holes are then filed square so that two pieces of iron about one-quarter inch square and three-sixteenths inch in length can be driven in the holes. Now cut a brass strip one-eighth inch wide and a little longer than the diameter of the frame and solder it parallel to the pole pieces, across one end of the tube. This is to be one bearing and a little solder can be put on the pole-pieces, to make sure that they stay in place, but before the brass strip is put on solder the pole-pieces and then file them concave so that the armature has a little clearance space between them to turn.

Place the drill holder with a number 60 drill in the chuck, in the vise and hold the brass strip up and drill thru the middle. This gives a hole of just about the right size for the shaft. Remove drill from chuck and put your three-sixteenths inch drill in its place. Bend a piece of card-board so that a square form is made, slightly larger than the square iron pole-pieces and slip this over the drill, with possibly a piece of friction tape over the drill to take up the difference and force over the card-board two pieces of the same material with square holes cut in them. Space these about one-eighth inch apart and you have a winding form to wind the field coils, which are about one-half inch diameter and made of No. 36 single silk-covered copper wire. When wound take care in removing the same from the form and by leaving a little wire at the end this wire can be past thru the hole in the coil a few times thereby securing the turns in place. Two pole-pieces of course means two coils, but before placing them on the iron pole-pieces, the inside of the frame should be insulated with a strip of Empire cloth with two



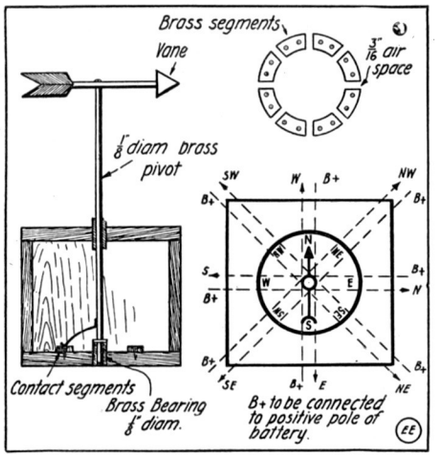
Details for Building a One-Watt Electric Motor.

square holes cut in it in order to allow it to pass over the poles. The poles themselves have a small piece of paper wound on them as insulation, held in place with shellac.

(*Continued on page* 573)

USING COMPASS AS WIND-DIRECTION INDICATOR.

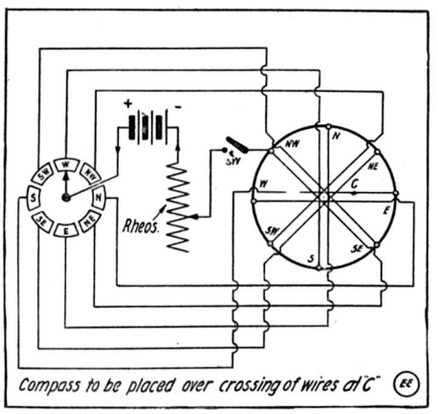
The underlying principle involved in the following apparatus is that a compass needle is deflected when brought near a current-carrying conductor. To make it



The Electrical Experimenter Will Find This "Compass Type" Wind-Direction Indicator Both Useful and Instructive.

more clear to those unfamiliar with the laws relating thereto, we shall take a specific case as an example: When a compass is placed over a wire in which the current is flowing South, the pole of the compass will be deflected toward the West; the amount of deflection varying according to the current strength. The greatest possible deflection is due West, or at *right angles* to the North-South wire. So if we provide sufficient current, the needle will point directly West. If the current flow were to be changed from Northward to Southward, the needle would point East. Thus, it can be seen that, by arranging connections with an outside weather vane, which creates a separate circuit for each of the eight principal geographical directions, and applying the principles as stated above, we may use the compass for indicating the direction of the wind.

The construction of the special weather vane and its operation are shown quite clearly in the drawings. The arrow, made from a shingle or other comparatively thin wood, is mounted at its balancing point upon a 1/8" diameter round brass rod. This rod or pivot turns freely in the brass bear-



Circuits Used for Electric Wind-Direction Indicator Built from a Magnetic Compass.

ings of equal inside diameter and is supported by the collar (soldered to it) which rests upon the lower bearing. From 1/8" brass sheeting are cut the segments, with which the spring brush makes contact. These should be screwed to upper surface of the bottom of the box at proper distances from each other, and around the bearing as a center. One-half inch wood serves for the box, which should be varnished and the cracks of which should be filled with paraffin to keep out rain, which would soon short-circuit and corrode the segments. Connections are made to each of the segments and the lower bearing.

Current-carrying wires which cause the deflection of the compass needle are placed in grooves cut in a small wooden block; two wires in each groove. These grooves may be cut in a mitre-box most easily. The wires should be about No. 18-20 B. & S. gage. If smaller, heating will result. The grooves are filled with wax or paraffin, which is then smoothed to level of block with sandpaper. During the operation the compass is placed directly over the cross of the wires shown at "C" in diagram.

Much care will have to be used in wiring the square block with the weather vane. However, if the drawings are followed closely, no trouble should occur. The rheostat is unnecessary, but with it the current is better regulated. The number of batteries will vary since compasses in each case will differ, as also will the distance from vane to inside block. Note that the battery is connected with the bearing from positive pole.

Contributed by J. L. TAYLOR, JR.

(*Ed. Note: While this is a very good experiment theoretically, the drain on the battery would prove excessive for continuous readings, unless gravity cells were used. However, for periodical readings the scheme is practical for use with dry or storage cells, utilizing a switch to close the battery circuit when making the readings.*)

A MYSTIC SHOW WINDOW ATTRACTION.

A novel device to attract the attention of passers-by to your display of goods is presented in the "inexhaustible drinking glass," which seemingly is suspended in mid-air without any visible means of support, emitting large quantities of water, apparently coming from nowhere.

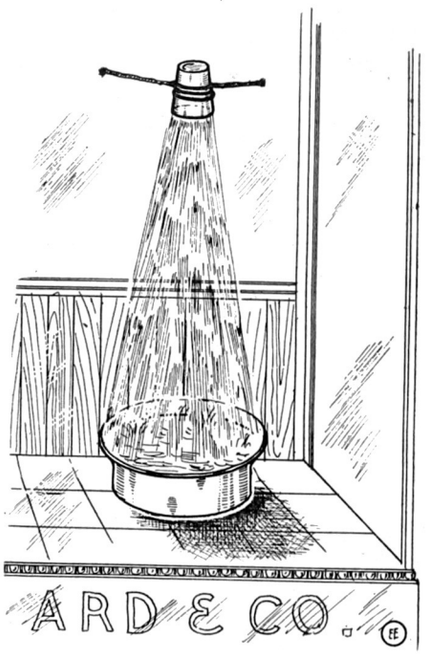
The illusion is set up as follows: Procure a tin-wash-basin and cut a quarter-inch hole in the center of bottom for the supply tube and a hole near the edge for a 3/4" drain pipe. Drill corresponding holes in floor of show window. The drain pipe can be made of tin, soldered in place and extending up into the basin to within about 3/4" from the top. The lower end leads thru the floor of window, where it connects with a rubber hose which carries off the waste water.

For the supply you will need a glass tube with an internal diameter of from 1/8" to 3/16" and long enough to extend from a few inches beneath the show window up into the basin to the same height as the pipe. When the tube is in place, apply a liberal amount of soft putty on the under side of the basin around the tube.

Place the basin in position in window, permitting the drain and supply tubes to extend thru their respective holes in the flooring. Adjust the glass tube in a perfectly vertical position and press down tightly, squeezing the putty in place to prevent leaks.

As city water pressure varies greatly, due to other consumers turning their faucets on and off when drawing water, the glass will not always remain at the same height, rising and descending with a jerky motion. To overcome this take a gallon can of any kind (an old varnish can will do), connect it to the city supply pipe and solder a small tube in the side, to which connect the glass tube with a small rubber hose. The illustration will explain this.

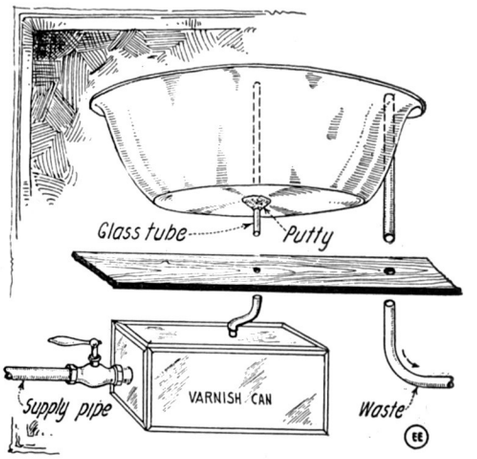
Invert a light weight, thin shell, drinking



The Mystic Electric Tumbler That Floats on a Stream of Water. Details for Building This Interesting Amusement and Show-Window Attraction Are Given in the Accompanying Article.

glass over the glass tube in the basin, and turn on the water slowly at first. The glass will rise in the air, resting on the stream of water. Its height can be varied with the stop cock. The water falling from the glass obscures the supply stream, and on striking the water in the basin it causes a wavy surface, thereby hiding the glass tube, its effect making the spectators wonder what is holding the glass up and where the water is coming from. A coil of wire slipt over the glass, with the two wire ends sticking out as illustrated, makes the device look "electrical." This serves merely to mystify the onlookers still more.

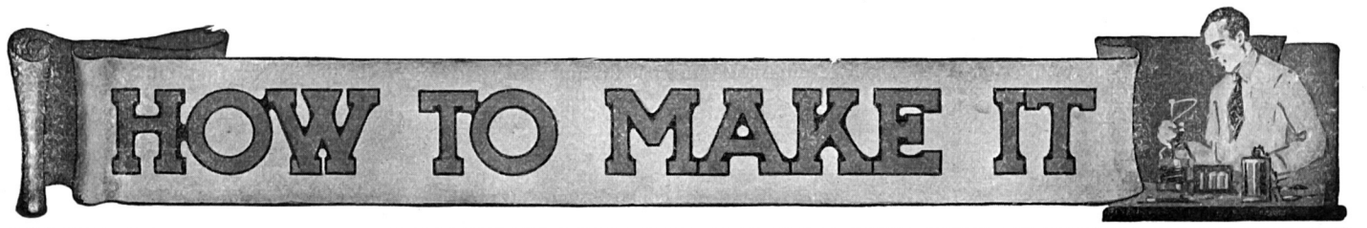
Contributed by GEO. NIEDERHOFF.



Details of Basin and Water Nozzle Used in Making the Mystic Tumbler.

WRITE ARTICLES!!!

Now is the time to write up that favorite "stunt." Make it brief—a hundred words or so will tell the story. Send a clear sketch, or better, a photograph of the rinktum. Address the Editor.



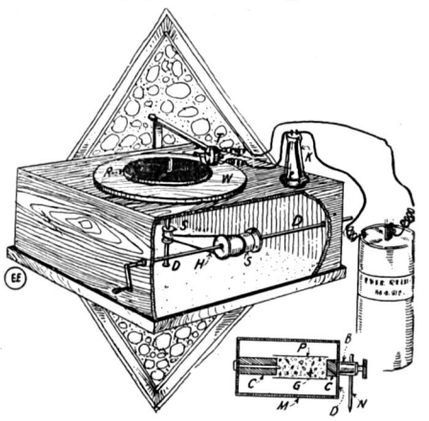
This department will award the following monthly prizes: First Prize, $3.00; Second Prize, $2.00; Third Prize, $1.00.

The purpose of this department is to stimulate experimenters towards accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best idea submitted a prize of $3.00 is awarded; for the second best idea a $2.00 prize, and for the third best prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

FIRST PRIZE, $3.00

AN ELECTRIC PHONOGRAPH REPRODUCER.

First a small box about 7"x10" is procured, then a round disc 6" in diameter is cut out (W). A ¼". dowel is fitted into center of the disc; on the same dowel a spool is fitted, a short piece of the dowel being left protruding thru the disc to put the record on. Next another dowel is fitted with a spool and crank, these two dowels and all attached are placed as shown in diagram. A transmitter is made from a round wooden box about 2" in diameter, a round carbon (C) is fastened to the bottom, a carbon of the same size is fastened to a thin tin diafram and on the same bolt a long binding post (B) is fastened, around the two carbons a piece of paper is wound; in between the carbons are carbon granules (G). A connection is taken from the diafram, and the bottom carbon. This transmitter is pivoted on an arm as shown. The needle (N) runs in the groove of the



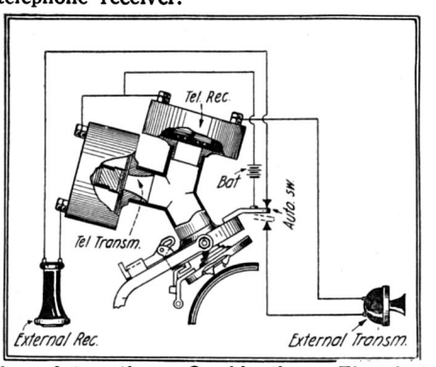
A Home-made Electrical Phonograph With Hand-drive Attachment of Simple Construction. This Idea Is An Excellent One for Experimentation.

record (R). A rubber band (H) is placed in position as shown, then when the crank is turned the wooden disc with the record turns around and the needle runs on the record. The wires from the transmitter are connected to a telephone receiver (K) and battery of two to three dry cells.

Contributed by HERMAN SLOBIN.

ELECTRICAL RECORDING AND REPRODUCING ATTACHMENT FOR PHONOGRAPHS.

A simple and particularly efficient design for an auxiliary electric recording and reproducing mechanism for attachment to phonographs is shown in the accompanying illustration, and this idea has been patented by Newman H. Holland. The usual recording and reproducing stylii are carried on a reversible platen or head, so that one or the other will be brought into contact with the phonograph record in the usual manner. Instead of connecting a horn to the acoustic chamber above the stylii and diafram, this chamber is foreshortened and splits up into two distinct or branch chambers, in one of which there is placed a micro-phone member and in the other a telephone receiver.

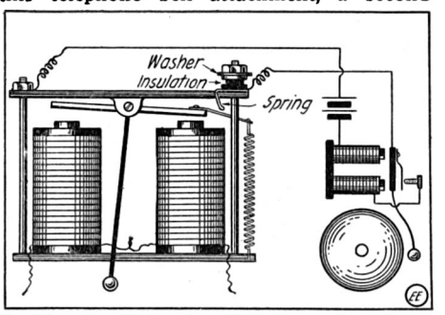


An Interesting Combination Electrical Recorder and Reproducer for Use on Phonographs.

SECOND PRIZE, $2.00

TELEPHONE RINGING ATTACHMENT.

I herewith submit a novel idea to the "HOW TO MAKE IT" department. With this telephone bell attachment, a second



To Ring An Extension Bell From Any Telephone Ringer, Simply Attach An Insulated Contact Spring to the Frame as Shown.

bell can be made to ring in any part of the house. A small piece of spring brass is bent so that it will hit the armature of the telephone bell when it comes up. With a few insulating washers, it can be attached to the frame very easily, as there is a bolt that extends thru the upper part of the frame. The nut is removed, and the spring slipt on. The door bell has a wire connected from the contact point to the spring, so that its interrupter will not work. Two batteries are sufficient to run it. It will ring every time the 'phone does.

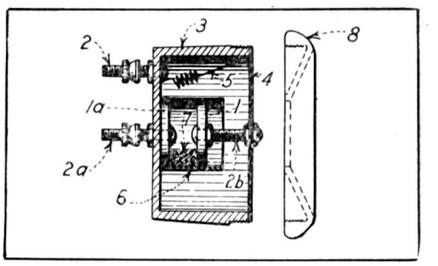
Contributed by EARL MEISSNER.

THIRD PRIZE, $1.00

CARBON GRAIN TRANSMITTER MADE FROM RECEIVER SHELL.

A simple yet efficient microphone may be constructed from the "junk" found around any experimenter's workshop.

Referring to the drawing: (1) and (1a) are disks sawed from an old round battery carbon. A 3/16" hole is drilled in the center of each. (2), (2a) and (2b) are battery binding posts. Binding post (2) is inserted thru a 3/16" hole in the back of the receiver shell (3) and connected to the diafram (4) by means of a small coiled wire (5). Carbon disk (1) is secured to the diafram (4) by means of battery binding post preferably a No. 6-32 rod (2b). (6) is a paper tube fitted over carbon disk (1a) and glued or shellacked so as to hold it firmly. Carbon disks (1) must be smoothed on its edge so as to allow it to vibrate, as the voice waves impinge against the diafram. (7) are carbon grains (scraped from an ordinary piece of carbon) placed in the paper tube (6) between carbon disks (1) and (1a). (8) is the receiver cap. Best results are obtained by using polished carbon grains which can



The Experimenter Will Find This Improvised Carbon Microphone Very Serviceable, Especially If Polished Carbon Grains Are Used In It.

be purchased from any electrical supply house.

Contributed by GEO. H. GORDON.

The microphone member on the phonograph is connected with a common battery as indicated, and also with a switch attached to the traveling phonograph carriage, so that when the phonograph is talking the speech is picked up by the attached microphone and sent out over a line of any desired length to the telephone receiver. In a similar manner the phonograph can be utilized for recording speech from a distance, by means of the external microphone, which is connected thru the common battery to the telephone receiver mounted in the second branch of the acoustic chamber on the phonograph carriage. This idea is often very useful in experimental and laboratory work.

HOME MADE GAS LAMP FOR THE DESK.

Many experimenters have undoubtedly wanted a desk lamp, but have never looked around the workshop for odd pieces of apparatus with which to make one.

A Quickly Made Desk Lamp Constructed from a Ring Stand, a Bunsen Burner, Goose Neck, Mantle and Globe.

The photo given here illustrates a method of making a desk lamp from the following pieces:

1 ring stand; 1 Bunsen burner, with the part removed as shown in photo, 1 regular goose-neck fixture, with mantle and globe; 1 burrette or test tube clamp.

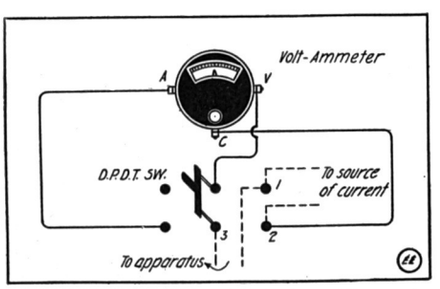
Assemble the apparatus as shown in the photo and you have a very satisfactory study table or desk lamp at insignificant cost.

Contributed by
ALBERT W. WILSDON.

VOLT-AMMETER SWITCHING SCHEME.

Probably many of the readers of this journal have desired to use a Volt-ammeter for measuring both the voltage and amperage without changing the wiring, but have been required to use two instruments, as this problem requires usually several switches and complicated wiring.

I have had this trouble, but have worked out a system of wiring which requires only one switch. The diagram is self-explanatory, and it will only be necessary to state that C is the common, A the amperage and V the voltage post of the meter. Post 1 is connected to both the source and apparatus; either 2 or 3 may be connected to the source, the other to the apparatus.



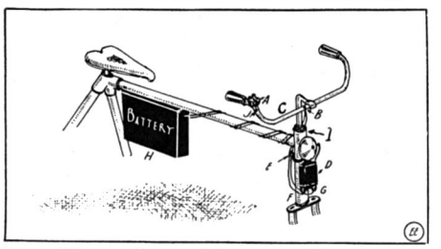
By Simply Throwing the Switch Shown to Either Right or Left, "Amperes" or "Volts" May Be Read On the Combination Volt-Ammeter.

Contributed by JOHN D. FORNEY.

ELECTRIC BELL FOR A BICYCLE.

The drawing shows a very simple electric bell for use on a bicycle which will make people jump, thinking it is an ambulance or an "electric." All that is necessary to make it is—an old door bell, a battery box, (like the one used with a bicycle electric light) some No. 12 insulated wire, a clamp, and an automobile push button (horn). It's very simple in construction. Direction:—Drill a hole in the under side of the handlebar at B, and one on the upper side at J; run the two wires thru and connect to push button A, clamp bell D to frame I, with clamp E, but be sure that it is well insulated or else the bell will ring continuously. Then attach battery box H, and run wires to G and F, also the push button and the bell is ready to work. I have been using the bell described for years, and as you can see at a glance, it is bound to be perfectly satisfactory. By using a two-point switch you can put a light on front and rear, wiring it to the same battery, as the bell consumes very little current. The bell may be placed on a motorcycle and use a storage battery, providing the bell is heavy wound.

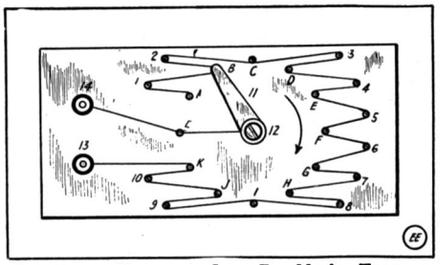
Contributed by
CLARENCE SOMERS.



Every Bicycle Owner Wants an Electric Bell Now. Here's the Way to Rig It Up.

A HANDY RHEOSTAT FOR LAMPS AND MOTORS.

Herewith is a diagram of a simple and quickly constructed rheostat. All the figures from 1 to 11, and all the letters from A to L, represent points of the rheostat, which are made by driving tacks so that they are about ⅛" high (from base). At 13 and 14 are two binding posts made from battery bolts; 11 is the movable contact arm. The base is 3" x 5". The tacks are driven in the form of two circles; the first circle has a diameter of 1" and the other circle has a diameter of two inches. There are 12 tacks on the inner circle and 10 tacks and 2 binding posts on the outer circle. All tacks are placed equal distances from each other in circles. Now connect A to 1 to B to 2 to C to 3 to D to 4, and so on around to 10 to K. The wire used is taken from an old telephone induction coil. Then connect 13 and K with a piece of bell wire and also 14 to L to 12 with same size wire. Arm 11 can be made from a piece of brass and 12 is a brass screw and two nuts from the carbon of a dry cell battery. The arm rotates to right to increase current (from 1 to 11), and decreases by rotating to left; to decrease current (from 11 to 1). This rheostat can be used for governing the speed of small motor, dimming battery lamps, etc.

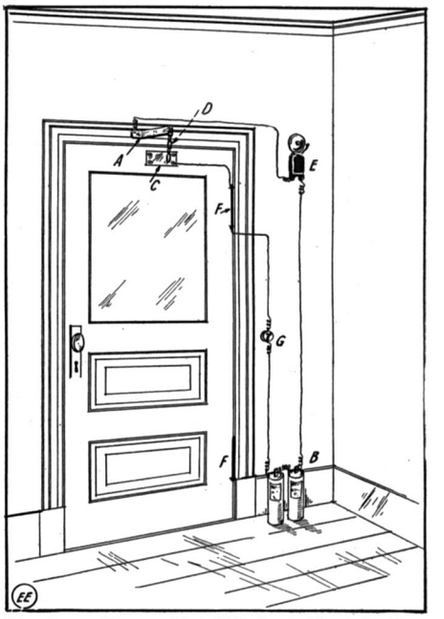


A Battery Rheostat Can Be Made From a Few Feet of Iron or Other Wire Looped Around Several Tacks as Here Illustrated.

Contributed by JOHN WELLS.

A SIMPLE ELECTRIC DOOR ALARM.

A simple door alarm can be made with very little cost, by first taking a piece of sheet copper 4 by 5 inches and cutting a piece 4 by 1 in. off for the arm as shown in sketch. Then fasten a piece of chain at the end of the arm long enough so that when door is opened, it will touch the lower plate 4 by 4 inches mounted on door as shown. This closes the circuit which rings the bell. The wire running from the door contact plate should be soldered to one of the hinges (F) and another wire should be soldered right on the same hinge, and run down to the switch (G), and from there to batteries (B).

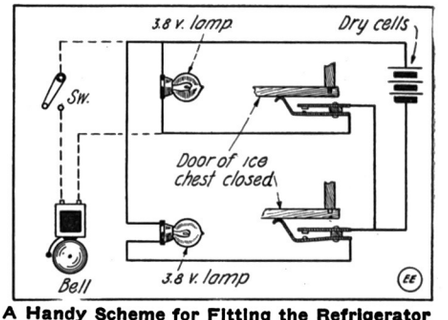


Here's a Cheap, Yet Efficient Electric Door Alarm Switch Made From a Piece of Metal Chain and a Brass Contact Plate.

Contributed by A. GRUETZMACHER.

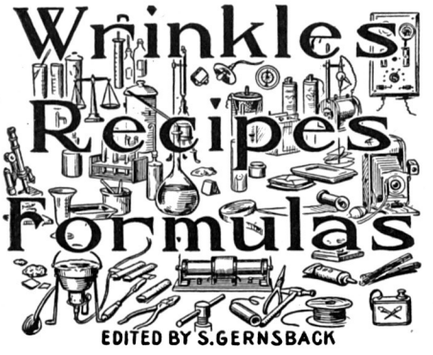
LIGHTING THE ICE CHEST.

As my refrigerator was out on my porch I found that the device described was very convenient for me, and by having it outside I thought a wire attached to the same circuit and brought inside to an alarm bell, would prove an excellent burglar alarm and it has worked to perfection. By having a refrigerator so lighted, one can go out to it and see what to get without the aid of any other light.



A Handy Scheme for Fitting the Refrigerator With Electric Light and Also a Burglar Alarm.

Contributed by G. B. McCARTNEY.



Under this heading we publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

EXPERIMENTER'S APHORISMS.

In the following, we wish to give to the Experimenter some hints as to the use of the different ingredients and how to work them:

(1) Always bear in mind that exact working of a formula requires ACCURACY, CLEANLINESS, PATIENCE, and SKILL.

(2) Know what you are about, before you start to experiment.

(3) "THE HISTORY OF FAILURES IS THE HISTORY OF SUCCESS" goes an old adage, and it applies well to the experimenter.

(4) Many times impure, wrong or deteriorated raw materials, spell FAILURE instead of SUCCESS.

(5) A great many of the chemicals and ingredients required, cannot be obtained from drug stores; buy them at a reputable supply house.

(6) BEFORE CONDEMNING A FORMULA, be sure the fault does not lie with the manner of handling it, or the purity of the ingredients.

(7) Be sure to mix the materials comprising a certain formula in the proper sequence.

(8) When starting to prepare a mixture, especially one containing liquids, ask yourself: "IS THE SPECIFIC GRAVITY CORRECT, AS INDICATED BY A HYDROMETER? IS THE TEMPERATURE RIGHT? IS THE QUANTITY OR WEIGHT RIGHT?

(9) Acids and water, when mixed, should be manipulated in the proper manner, i. e., THE ACID SHOULD BE POURED INTO THE WATER, and not vice versa, as the solution is liable to be forcibly ejected from the containing vessel and into the mixer's face.

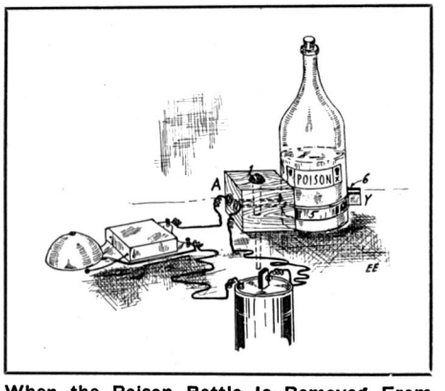
(10 For any kind of SYSTEMATIC WORK, a floating THERMOMETER and HYDROMETER, as well as measuring glasses and scales, should always be provided, as GUESSWORK is EXPENSIVE, and SOMETIMES FATAL.

(11) Put labels on ALL bottles, boxes and packages with FULL INSCRIPTION as to their contents, it will avoid troubles and mistakes.

(12) Remember that a beginner cannot expect to make articles AT FIRST, which will compare with regular manufactured products.

ELECTRIC WARNING FOR POISON BOTTLES.

This instrument is used in two ways as follows: The clamps 5 and 6 in illustration



When the Poison Bottle Is Removed From the Contact Strips, They Spring Together, Closing an Alarm Bell Circuit.

serve to fasten bottle to avoid its falling from shelf, and also to notify an ignorant person of the presence of poison. Proceed to first construct upright, A, 2" high, 1½" wide, and ¼" thick. Fasten block to shelf by screw 1. At any height put in binding posts on block, as shown in figure. Construct clamps 5 and 6 out of old clock springs heated, bent in above design and retempered. These should be constructed according to the circumference of bottle, leaving ¼" between X and Y.

Connect spring arms at posts and connect posts to batteries and warning bell as indicated in figures. When at night, anyone removes the bottle the springs come together and thus make contact accordingly. The bell rings as warning of poison.

Contributed by JOHN WEINZIL, JR.

CHEMICAL GROWTHS RESEMBLE FOLIAGE.

The following item may prove of interest to your chemical readers and those who dabble in chemistry just for the novelty of such experiments as this:

A 10% solution of sodium silicate (water glass) is put into a glass or beaker, and crystals of any or all of the following salts are dropt in; copper sulfate, ferrous sulfate, nickel sulfate, cobalt nitrat. Many other salts will give similar results but the various sulfates appear to be the best.

Shortly after the crystals are placed in the solution, they will begin to grow in fantastic shapes, each of the salts giving a different growth of different color. These growths look so much like undersea foliage that they have often been called "Submarine Gardens."

The rate of growth depends on the strength of the silicate solution as the crystals are due to a formation of the silicate of the salt used. A solution of the strength mentioned above allows the crystals to grow in a more even manner at a rate which can be watched. The growths, however, will not keep unless the solution is very weak, and then they grow too slowly.

Contributed by JEROME S. MARCUS.

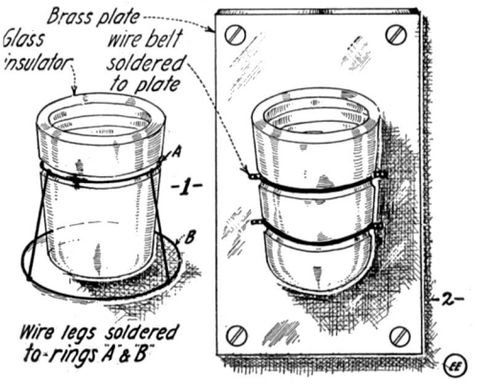
RELATIVE ELECTRICAL CONDUCTIVITY OF DIFFERENT METALS AND ALLOYS.

Metals	Relative Conductivity
Pure silver	100.
Pure copper	100.
Refined and crystallized copper	99.9
Telegraphic silicious bronze	98.
Alloy of copper and silver (50%)	86.65
Pure gold	78.
Silicide of copper, 4% Si	75.
Silicide of copper, 12% Si	54.7
Pure aluminum	54.2
Tin with 12% of sodium	46.9
Telephonic silicious bronze	35.
Copper with 10% of lead	30.
Pure zinc	29.9
Telephonic phosphor-bronze	29.
Silicious brass, 25% zinc	26.4
Brass with 35% zinc	21.59
Phosphor-tin	17.7
Alloy of gold and silver (50%)	16.12
Swedish iron	16.4
Pure Banca Tin	15.5
Antimonial copper	12.7
Aluminum bronze (10%)	12.6
Siemens steel	12.
Pure platinum	10.6
Copper with 10% of nickel	10.6
Cadmium Amalgam (15%)	10.2
Dronier mercurial bronze	10.14
Arsenical copper (10%)	9.1
Pure lead	8.88
Bronze with 20% of tin	8.4
Pure nickel	7.89
Phosphor-bronze, 10% tin	6.5
Phosphor copper, 9% phos	4.9
Antimony	3.88

TWO USES FOR GLASS INSULATORS.

The accompanying drawings show two methods of how glass telephone insulators and some stiff wire can be so constructed and utilized as useful receptables for matches, drills, screws, acids, et cetera, in any experimenter's laboratory. Figs. 1 and 2 show plainly how the wire is bent and soldered.

Contributed by JOHN M. MUNSONS.



Handy Receptacles for Matches, Screws, Etc., Made From Wire and Glass or Porcelain Insulators.

A FORTUNE-TELLING EXPERIMENT

Procure a cylindrical carton about 2½ inches in diameter and at least a foot in length. Place in the bottom of this carton a small bottle, preferably an ink bottle, containing some pieces of iron sulfide (Fe_2S_2) covered with either hydrochloric or sulfuric acid. The cork of this bottle should have a hole about ⅛ inch in diameter drilled thru it to allow the escape of the generated hydrogen sulfide gas. About an inch or so above this bottle (or generator) a round piece of perforated cardboard is held in place by resting on four common pins, the latter being placed at the ends of two diameters which are perpendicular to each other. These pins are thrust thru the wall of the carton so that they protrude on the inside; thereby forming a basis of support for the perforated cardboard. The holes in the latter should be about ⅛ inch in diameter. Take a pad of ordinary unruled paper and write various fortunes on each sheet with a solution of lead acetate, commonly known as sugar of lead. The solution being colorless, the pad paper will appear to have no writing on it.

In telling the fortunes of your friends, have one of them sign his or her name on the top of a sheet of this pad. Tear this sheet off. Have another friend place his or her name on another sheet of the pad. After having three or four signed sheets, roll them up, place them in the carton, and quickly cover. Keep your friends interested by quoting some magic patter, and after placing the carton to the four winds and going thru some magic motions, remove the cover and take out the roll of paper. Immediately cover the carton. Then distribute the sheets of paper to those whom the signatures designate. Behold! Your friends will receive the same signed sheets of paper covered with black writing which upon reading will tell their fortunes.

The chemistry involved in this experiment is the formation of the black precipitate of lead sulfide by the generated hydrogen sulfide (H_2S) coming in contact with the lead acetate $Pb(C_2H_3O_2)_2$ on the paper.

$$Pb(C_2H_3O_2)_2 + H_2S = PbS + 2HC_2H_3O_2$$

Contributed by
FRANK BECHTOLD, JR.

Experimental Chemistry

By ALBERT W. WILSDON

Nineteenth Lesson

LAWS OF CHEMISTRY

THERE are certain laws of chemistry which the reader should study and memorize, previous to taking up Electrolytic chemistry. There are two FUNDAMENTAL LAWS, namely, the *"Law of Conservation of Matter"* and the *"Law of Definite Weight."* The Law of Conservation of matter states that *the weight of the sum of all the products in an experiment is exactly equal to the weight of the sum of all the factors.* The

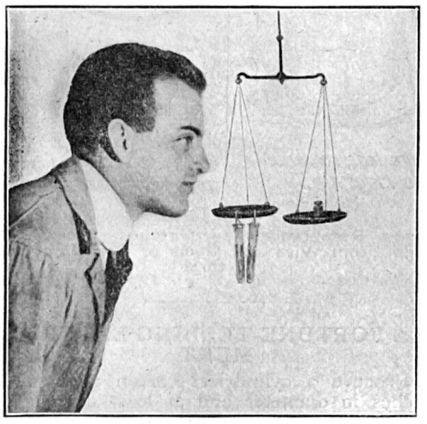


Fig. 93.—Illustrating the Law of Conservation of Matter with Two Balanced Test Tubes, Containing Two Different Solutions.

factors are the substances used to make an experiment; the products are the substances obtained.

Thus, Hydrochloric acid is the product of the combination of the two factors hydrogen and chlorin, expression of which reaction is as follows:

$$\underset{\text{(factors)}}{H + Cl} = \underset{\text{(product)}}{HCl}$$

By this law is meant that chemical experiments can neither create or destroy matter. We may form new substances, separate elements from compounds, make compounds from elements, change solids to liquids or invisible gases, and gases to liquids or solids. We cannot create or destroy matter, therefore, matter is indestructible and uncreatable, as physics teaches us that energy is. *Amount of matter is always determined by weight, not by volume.*

Properly understood, every equation, as well as every experiment, illustrates this law. If we were to take any chemical equation and count the number of atoms of any given element, on the right of the equality sign (the products), we will find that it is the same as the number on the left (the factors). The compounds are changed, but the atoms are the unchangeable things, as Dalton declared them to be when he named them *atoms,* which in Greek means "uncutable."

Let us now take an equation and count the number of atoms on each side of the equation:

$$\underset{\text{(factors)}}{Zn + 2HCl} = \underset{\text{(products)}}{ZnCl_2 + H_2}$$

Here we find that we have for factors, 1 atom of Zinc, which reacts with Hydrochloric acid, composed of 2 atoms of hydrogen, and 2 atoms of chlorin. For products from the above factors we have (a) 1 molecule of Zinc Chlorid, composed of 1 atom of Zinc, and 2 atoms of chlorin, and (b) 2 atoms of hydrogen.

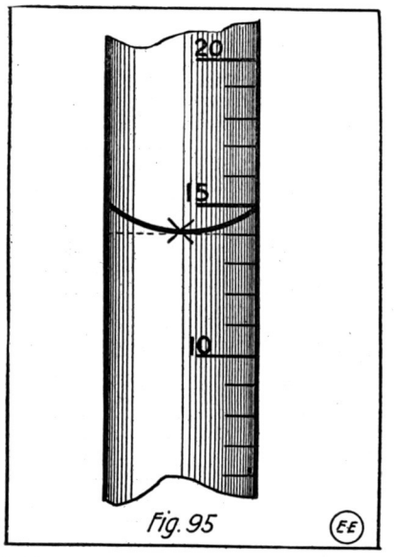
Let us now count the number of atoms for each element and compound, and see if they are balanced in accordance with this law. On the left hand (the factors) we have 1 atom of zinc, which is also shown on the right hand as a product contained in the molecule of zinc chlorid. As another factor we have 2 atoms of hydrogen in the 2 molecules of Hydrochloric acid ($2 \times H = 2H$), as a product we have 2 atoms of hydrogen liberated. As another factor we have 2 atoms of chlorin within the 2 molecules of hydrochloric acid, which is also seen as a product combined in the Zinc Chlorid. Thus the equation is properly balanced.

Law of Definite Weight (also called the Law of Fixt Proportions).—*Any given chemical compound always contains the same elements, and in the same ratio by weight.*

There are two parts to this law. One is that a given compound is always made up of the same elements. Hydrochloric acid is always composed of hydrogen and chlorin, as its ultimate constituents; never anything else. The other part of this law is that these elements always have the same ratio by weight. Thus in hydrochloric acid, that ratio is 1 of hydrogen to 35 of chlorin—1:35. The ratio does not vary; it is the same as yesterday and always has been the same; it always will be. The experiments which prove the first part of the law prove the second part also. Any chemical experiment, in fact, illustrates it.

The practical application of this law is that if you take too much of one of the factors in making an experiment, only a part of the reaction will take place, and the excess will be left behind unacted upon; in some cases a different substance from that wanted may form.

In large chemical industries it is almost



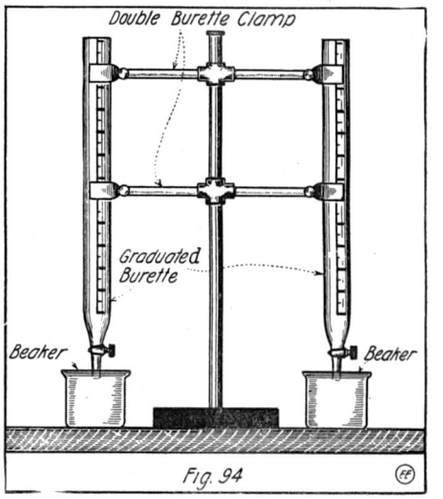
This Illustrates How Readings Are Correctly Taken from the "Bottom" of the Meniscus in a Tube Containing a Fluid.

as necessary to know the right proportion for mixing substances as to know what to put together. Suppose we wish to prepare some ferrous sulfid (FeS) from its elements; in what proportion should we mix the latter? The equation which stands for the reaction must first be written: Fe+S=FeS. Next the atomic and molecular weight must be affixt;

$$\underset{\text{Atomic Weights}}{Fe + S} = \underset{\text{Molecular Weight}}{FeS}$$

$$56 + 32 = 88$$

This means that when iron and sulfur unite to form ferrous sulfid, 56 parts by weight of iron always unite with 32 parts of sulfur



Illustrating the Law of Fixt Weight, Experiment No. 109, by the Aid of a Double Burette.

(or some multiple or submultiple of these numbers) to form 88 parts of ferrous sulfid. We should then mix the elements in the proportion of 56 grams of iron to 32 grams of sulfur, or 7 to 4. 56 to 32 forms a ratio which may be divided by the common factor 8. Let us suppose we have 10 grams of iron, how much sulfur will combine with it?

The work should be arranged as follows, placing x under the required or unknown substance (this being Sulfur in this case), and 10 under the known or given substance (Iron in this case).

$$\begin{array}{ccccc} Fe & + & S & = & FeS \\ 56 & + & 32 & = & 88 \\ 10 & & x & & \end{array}$$

Evidently there is the same ratio between 56 of iron (Fe) and 32 of Sulfur (S) as between 10 of Fe and x of S. This gives the following proportion:

$$\begin{array}{ccccccc} 56 & : & 32 & :: & 10 & : & x \\ 56\,x & & = & & 320 & & \\ x & & = & & 5.7 & & \end{array}$$

Proportion being an equality of ratios, we have: 56 : 32 :: 10 : x. Or we may write it

$$\frac{56}{32} = \frac{10}{x} \qquad \text{or} \qquad \frac{56}{10} = \frac{32}{x}.$$

All give the same result. Thus 5.7 grams of sulfur are needed to combine with 10 grams of Iron.

Again, we wish to know how much ferrous sulfid will be made? Arrange and solve as follows:

$$\begin{array}{lll} Fe + S = FeS & 56:10::88:y & 15.7 \text{ grams of} \\ 56 + 32 = 88 & 56y = 880 & FeS \\ 10 \quad y & y = 15.7 & \end{array}$$

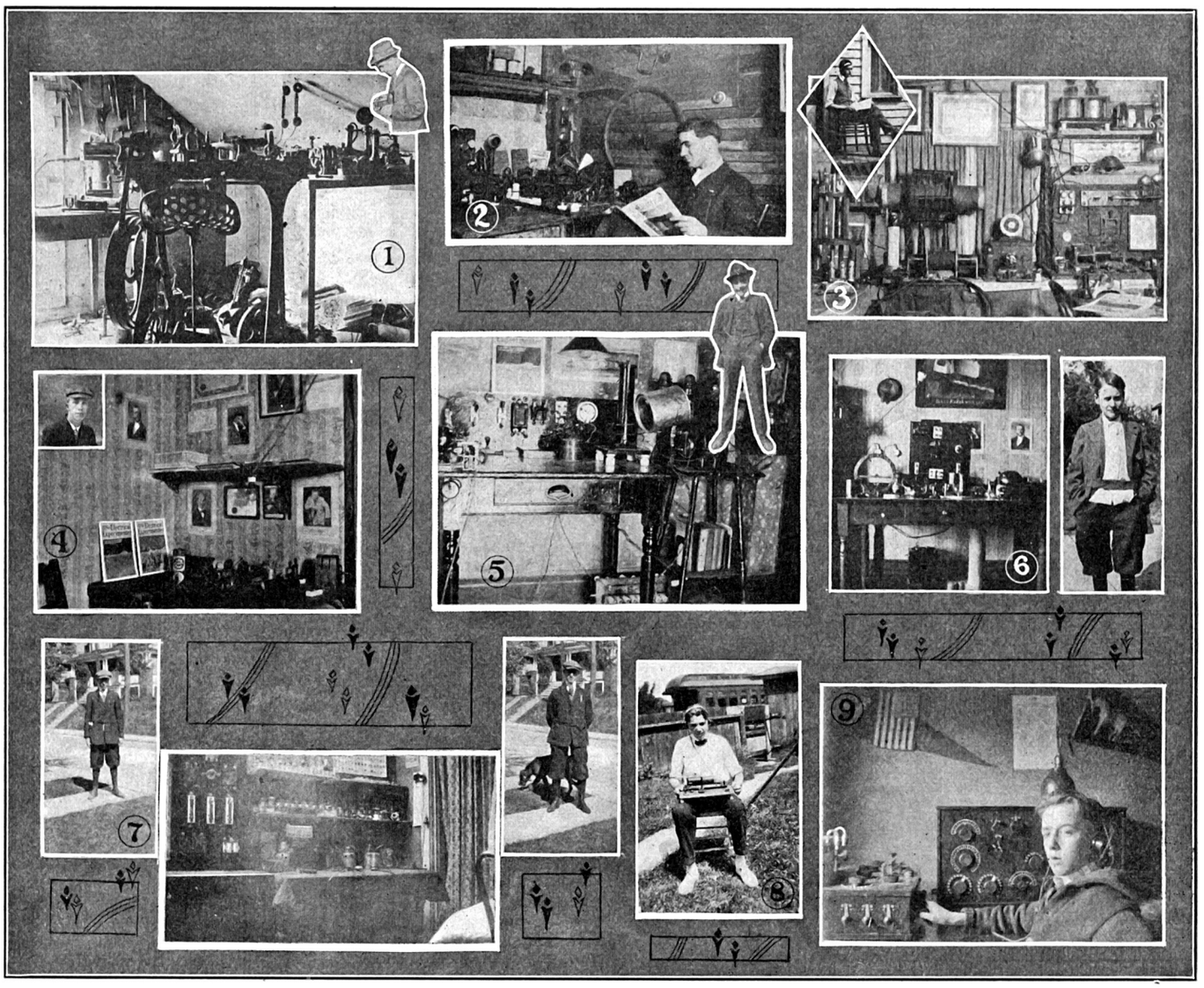
(*Continued on page* 559)

WITH THE AMATEURS

Our Amateur Laboratory Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of apparatus unaccompanied by that of the owner. Dark photos preferred to light toned ones. We pay each month $3.00 prize for the best photo. Make your description brief and use only one side of the sheet. Address the Editor, "With the Amateurs" Dept.

Those "Electrical Laboratory" Photos!!!

Well, "Radio-bugs," it seems that you are at last awakening to the fact that your Uncle Samuel has really gone to war, and that such being the case, the "Radio Labs.," of more peaceful times have actually slipt into oblivion, for the time being. 'Tis a mark of distinction to be the owner of a "good" electrical laboratory in these times. Don't go about the reorganization of your "Lab." with a half hearted spirit. On the contrary, let your motto be, "I will study and observe so that I can be of service to my country when the time comes!" You radio enthusiasts should open up your minds to the vast possibilities of "experimental electricity." If you possess a laboratory you, young man, may discover the "germ" of a far-reaching electrical idea which would be of inestimable value to Uncle Sam. And you will be rewarded, never fear. Fortune—Fame—Honor—all these come to the genius who, by patient experiment and study evolves a "new idea" that works. We hope to hear from every owner of an "Electrical Lab.," with a photograph of his *favorite corner*, as well as a likeness of the owner. And come to think of it—don't the "Girls" experiment? Address the Editor "With the Amateur's Prize Contest."



A GROUP OF REPRESENTATIVE AMERICAN AMATEUR LABORATORIES.

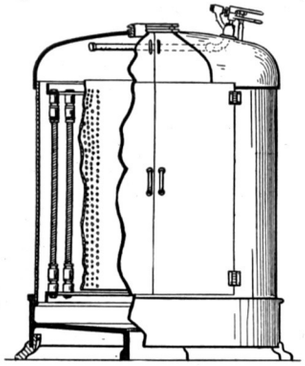
Electrical Laboratories of, 1—L. W. Hagerman, Racine, Wis. (Prize Winner); 2—Burnie Lazette, Monroe, Mich.; 3—J. N. Edwards, Bluefield, W. Va.; 4—Clarence F. Kramer, Lebanon, Ind.; 5—Osmond S. Ryer, Pasadena, Cal.; 6—Robert W. Field, Owensboro, Ky.; 7—Thos. D. Churchill and S. Goldhamer, Toronto, Can. Radio Stations of, 8—Jack Herzog, Lafayette, Ind.; 9—Kirk E. Smith, West Springfield, Mass.

LATEST PATENTS

Electric Bath-Cabinet

(No. 1,241,234; issued to Honora C. Marrinan.)

This combination electric heating and hot water bath is suitably

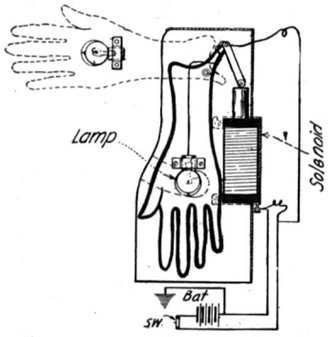


designed so that the proper degrees of heat can be produced from a series of electric heating coils, placed around the interior of the bath cabinet. The heat reaches the bathing chamber occupied by the person using it, in the most efficacious manner possible. One of the principal features of this bath cabinet lies in the interlocking electric switch and hot-water valve levers. The hot-water valve and electric switch control is so arranged that the turning on of said switch or valve prevents the turning of the other.

Electric Automobile-Signal

(No. 1,238,430; issued to G. H. Nierman.)

A semaphore type of electric automobile signal intended for at-

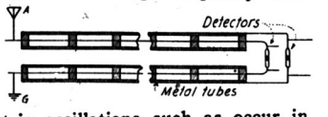


tachment on mud-guard of such vehicles and controllable from the driver's seat. The hand or other figure can be moved to a horizontal position, as shown in the illustration, by means of a magnetic solenoid, which is connected with the car storage battery or to a separate battery, as conditions may dictate. The movable hand forming the signal is fitted with a small incandescent lamp for night signaling, and the lamp may be cut out during the day. The solenoid core is connected to the movable signal arm by a flexible link motion as shown.

Intensifier of Radio Oscillations

(No. 1,235,650; issued to David W. Brown.)

An extremely simple form of intensifier for high frequency elec-

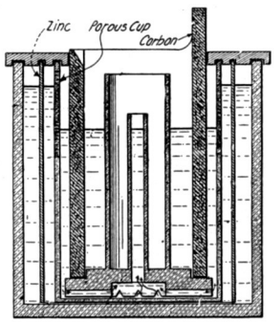


tric oscillations such as occur in wireless receiving circuits, and involving simply the use of two metal tubes, or their equivalent, thru which the aerial and ground lead wires pass to the detector. These envelops or tubes also become themselves highly electrically excited when oscillations from the aerial travel along the lead wires within them, and may be connected to other detectors having their own local circuits and translating instruments, such as telephone receivers, etc., as here indicated. Thus, it is possible with this arrangement to use two detectors and recorders.

Galvanic Battery

(No. 1,240,885; issued to Richard Schuster.)

This galvanic cell employs two electrolytes, is said to be odorless, and especially adapted for charging storage batteries. Its novel feature resides in the provision of a container or standpipe with over-flow ascending pipe, arranged centrally of, and in communication with the

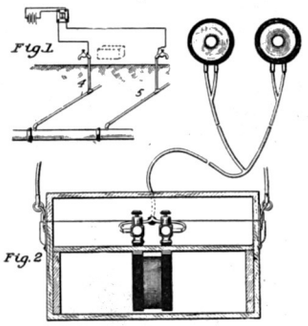


cathode cell, for the purpose of receiving the products of decomposition given off by the cathode electrolyte. The battery consists of an outer jar, a porous cup containing the cathode electrolyte, a carbon member, and in the annular space between the jar and porous cup, the anode electrolyte and the annular zinc member. All of these parts being nested in a well-known manner. The cathode electrolyte consists of a solution of bichromat of soda, water and sulfuric acid. The anode electrolyte comprises a caustic potash solution mixed with water. The upper part of the porous cup is made impervious to the electrolyte. The cell gives 2.7 volt and it is also reversible in action.

Electrical Detector for Underground Pipes

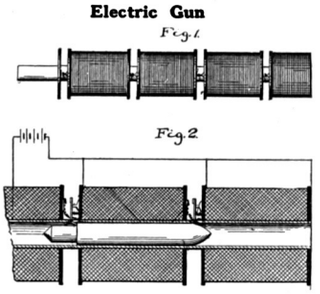
(No. 1,241,963; issued to Edward H. Grove.)

It is first necessary to connect a source of interrupted current to two



different taps on the pipe line, as shown in the diagram. This detector comprises a small magnet coil connected to a pair of sensitive telephone receivers, which are held to the ear. The operator proceeds to hold the detecting instrument by its supporting strap just above the ground as in Fig. 1, in a position at an angle to the pipes 4 and 5. While so holding the exploring coil, and walking about, the operator proceeds to swing the instrument in the direction of its length. When swinging the coil, the operator may move along naturally. When he is directly over the sought pipe, the sound in the telephone receivers will be as loud at one limit of the swing as at the other.

Electric Gun



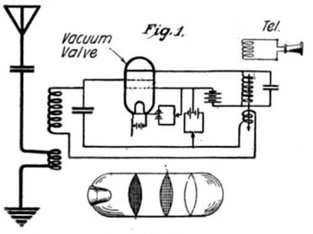
(No. 1,241,333; issued to Levi M. Bowman.)

Another patent on electric guns, and having for its principal novelty the particular automatic switch arrangement shown, whereby the movement of the projectile along the barrel successively trips the switch connecting in circuit the coil just ahead of the projectile. Thus it becomes evident how each succeeding magnet coil will act on the projectile progressively, so that by the time it reaches the end of the barrel, it will have acquired a high velocity.

Valve Receiver for Radio Signals

(No. 1,238,869; issued to George M. Wright.)

Receiver for radio signals, com-

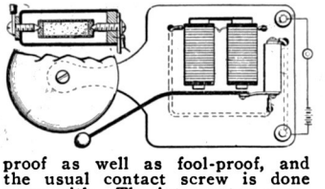


prising an evacuated vessel containing a heated filament, two grids and an anode. The inventor states that he is thus able to limit the strength of the current in the anode circuit, with the result that the sounds caused by atmospherics in the telephone will be considerably reduced, and will thus be prevented from over-powering the sounds caused by the signals which it is desired to detect.

Vibrator for Electric Bells

(No. 1,242,038; issued to W. E. R. Rademaker.)

This patent covers a unique design of vibrating interrupter for electric bells, which is of such a type that it can be made dust-

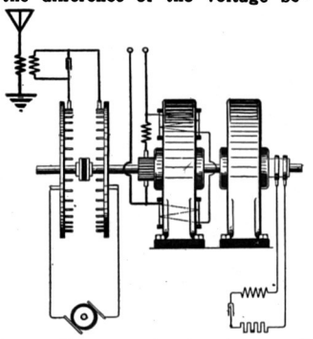


proof as well as fool-proof, and the usual contact screw is done away with. The interrupter member of this bell comprises a movable electrode of carbon or metal, delicately mounted within a small tubular chamber secured to the bell frame. When the circuit is closed thru the bell and interrupter, the electro-magnets are excited to their full maximum and the resulting vibration due to the armature striking the magnets, jars the interrupter electrode, thus opening the circuit momentarily.

Radio Frequency Oscillation Generator

(No. 1,240,206; issued to Raymond A. Heising.)

This radio-frequency oscillation generator is unique in that no spark gap is utilized. The high frequency oscillatory circuit is charged by a rapidly rotating commutator from a high-voltage direct-current generator, at those times during the cycle at which the difference of the voltage be-

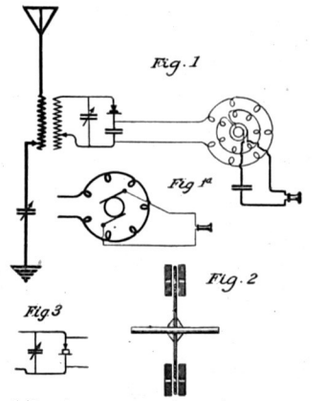


tween the generator terminals and that across the oscillation circuit is small. This invention covers special means for obtaining a constant speed in the commutator-driving device; this device comprising an alternating current generator, rigidly connected to the shaft with a D. C. motor connected to an external D. C. source of energy.

Radio Receiving Apparatus

(No. 1,241,565; issued to Harry Shoemaker.)

This undamped wave receptor patent employs a small alternating current generator, having a speed adapted to produce alternations of a frequency best adapted to operate a telephone diafram, say 900 cycles, and the windings of the machine are so connected that rectified energy in the detector circuit will pass thru its field,



while the current from its armature will pass thru the telephone. The telephone will then be subjected to a sinusoidal electromotive-force which will be substantially proportional to the current flowing thru the fields. This in turn will be proportional to the receiving energy or the number of wave trains received per second.

COPIES OF ANY OF THE ABOVE PATENTS SUPPLIED AT 10c EACH.

Phoney Patents

Under this heading are publisht electrical or mechanical ideas which our clever inventors, for reasons best known to themselves, have as yet not patented. We furthermore call attention to our celebrated Phoney Patent Offizz for the relief of all suffering daffy inventors in this country as well as for the entire universe.

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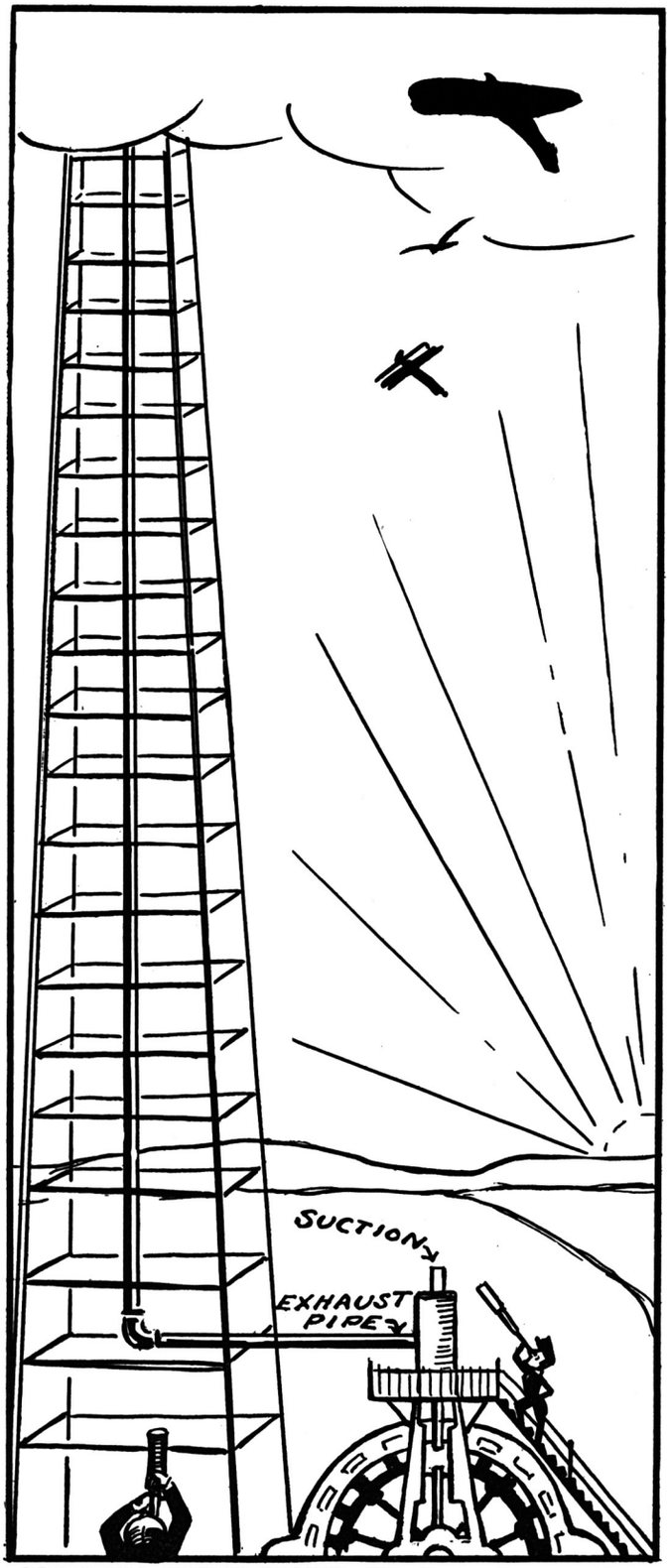
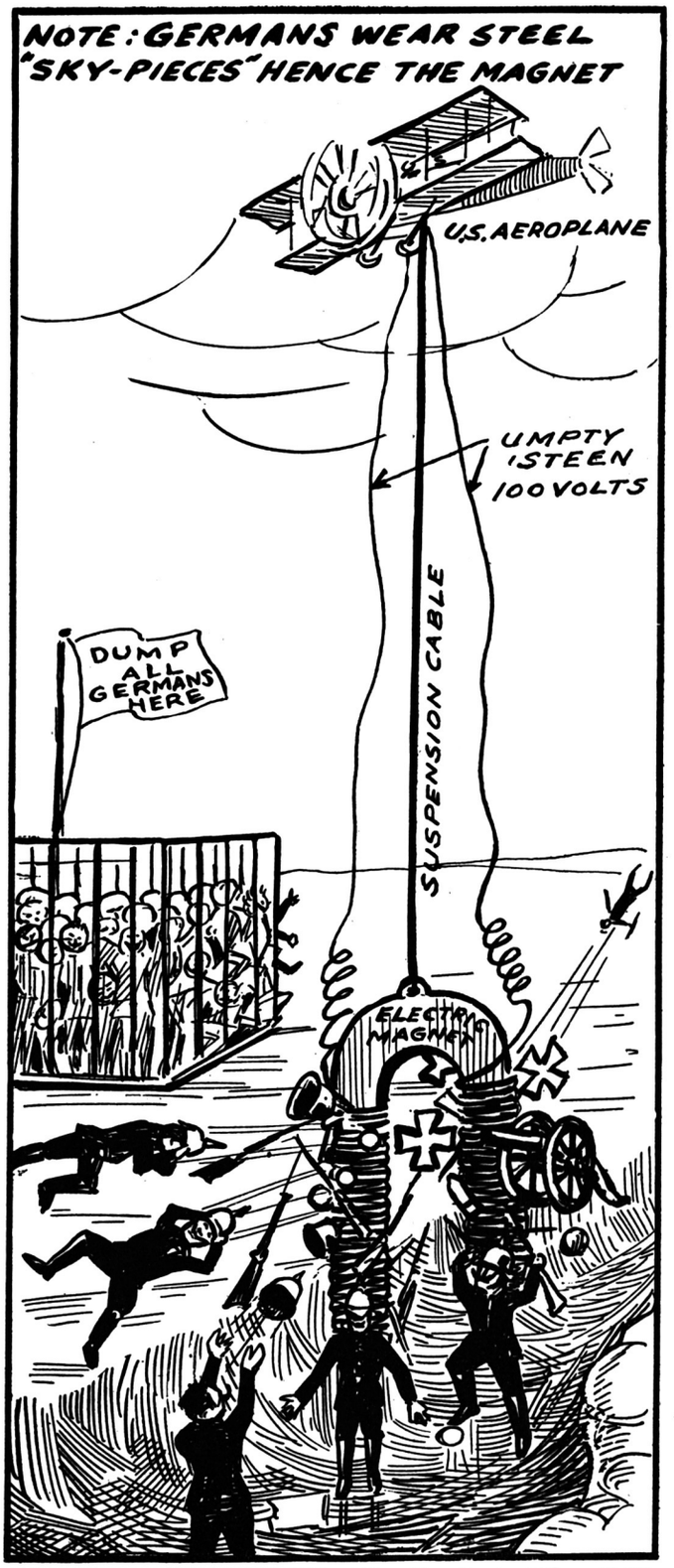


PERPETUAL MOTION ENGINE. This Engine Runs on Air Instead of Steam. The Engine Takes In Air At 14.7 Lb. Pressure At Suction Pipe and Exhausts the Same 40 Miles Above the Earth Into a "Vacuum," Or the Highly Rarefied Upper Atmospheric Strata. It Costs Nothing to Run. Inventor, Evert Pool, Hobart, Okla.



Prize Winner.—HUN-CATCHER.—Why Not Equip Those 20,000 Yankee Aeroplanes With Powerful Electric Magnets? The Magnets Attract the Steel "Sky-pieces," the Attached Huns, Guns, Gas Tanks and All. Dump 'em in Convenient Cages and Let Billy Bryan Talk the Kaiser Out of 'Em. Inventor, Joseph Wachtman, West Fairview, Pa.

QUESTION BOX

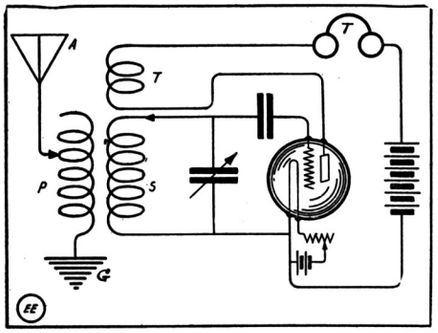
This department is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

1. **Only three questions can be submitted to be answered.**
2. **Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.**
3. **Sketches, diagrams, etc., must be on separate sheets. Questions address to this department cannot be answered by mail free of charge.**
4. **If a quick answer is desired by mail, a nominal charge of 25 cents is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.**

AUDION TICKLER COIL.

(861.) John Andrews, Philadelphia, Pa., asks:

Q. 1. What does the term *tickler* coil mean?



Hook-up for Audion with Inductively Coupled "Tickler" Coil at "T."

A. 1. There have been a large number of experimenters asking the same question. The term tickler coil refers to a coil which couples electromagnetically the wing and grid circuits of an Audion, so as to make it oscillate. A standard circuit in which a tickler coil is employed is shown in the accompanying drawing. The coil "T" is the tickler coil which is coupled to the secondary; it reacts on the grid circuit thru the stopping condenser.

GASOLINE ENGINE QUERY.

(861-A.) Wilbur Brown, Ontario, Canada, wishes to know:

Q. 1. Does a two H. P. gasoline engine of the marine type use any more gasoline than a gasoline engine of the hit and miss type of the same H. P. such as used for farm use.

A. 1. It is impossible for us to tell you whether the marine type engine draws more gasoline than the other type as the amount of gasoline depends upon several factors, namely: load, leak of compression, due to poor valve speed, type of carburetor and the general characteristics of the engine.

Q. 2. Would a ¼ in. spark coil work any better or carry any farther in a ground telegraph system than a buzzer.

A. 2. A ¼ inch spark coil would work better than a buzzer for a ground telegraph system.

Q. 3. How many glass plates 3½ x 3½ will be required for a condenser to be used on an Oudin coil 3 inches in diameter and consisting of about 500 turns of No. 35 double cotton covered wire.

A. 3. Twenty-five plates will be required.

AUDION PHENOMENA.

(862.) John Pils, Chicago, Ill., inquires:

Q. 1. What is the exact action that takes place in an Audion when used as a rectifier of radio frequency currents, or amplifier of audio frequency currents?

A. 1. It would be impossible for us to give you an exact explanation of the phenomena that take place in an Audion in this column. The general operating characteristics of this device depends upon the relation which exists between the potential on grid and the current in the plate or wing circuit with respect to the filament. A very thoro treatise of the operating characteristics of the Audion has been publisht in the August, 1916, issue of this magazine. It is worth 35 cents a copy.

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As to what to photograph: Well, that's hard for us to say. We leave that up to you, and every reader now has the opportunity to become a reporter of the latest things in the realm of Electricity, Radio and Science. But, please remember—it's the "odd, novel or practical stunts" that we are interested in. Every photo submitted should be accompanied by a brief description of 100 *to* 150 *words. Give the "facts"—don't worry about the style. We'll attend to that. Enclose stamps if photos are to be returned and place a piece of cardboard in the envelope with them to prevent mutilation. Look around your town and see what you can find that's interesting.*

Address photos to—Editor "Odd Photos," ELECTRICAL EXPERIMENTER, *233 Fulton Street, New York City.*

CONDENSER QUERY.

(863.) Andrew Hall, Pittsburgh, Pa., asks:

Q. 1. Between what points on a condenser scale does the capacity vary as a linear equation?

A. 1. Between 10° and 160°.

Q. 2. Is it possible to make a condenser with a zero capacity at zero scale?

A. 2. No, as it is impossible to shield or to reduce sufficiently the electrostatic field produced by the edges of the plates when the movable plates are set zero degrees on the scale.

Q. 3. How is the Seibt condenser built?

A. 3. The Seibt variable condenser is made out of one solid aluminum casting and the plates, both movable and stationary, are machined out from the same. With this process of manufacture the variable condenser is made very accurate and the space between plates is reduced very considerably, thus increasing the capacity of the condenser. The capacity of this type of condenser is much higher than that of a built-up condenser of the same size.

PROPERTIES OF RUBIDIUM.

(864.) Frederick Handel, Brooklyn, N. Y., writes the "Question Box":

Q. 1. What are the properties of rubidium metal?

A. 1. The specific gravity of the metal is 1.52. It melts at 38.5° centigrade; while at 10° it is as soft as wax. It is a lustrous silver white metal, with a tinge of yellow, oxidizes rapidly in the air, developing much heat and soon igniting. Volatile as a blue vapor below a red heat. The metal does not keep well under petroleum, but is best preserved in an atmosphere of hydrogen. Next to caesium it is the most electro-positive of all metals.

Q. 2. Does lead acetat precipitate from neutral or acetic acid solutions?

A. 2. Yes, the product of the reaction is a yellow lead chromat and the equation shows the reaction between lead acetat and sodium chromat.

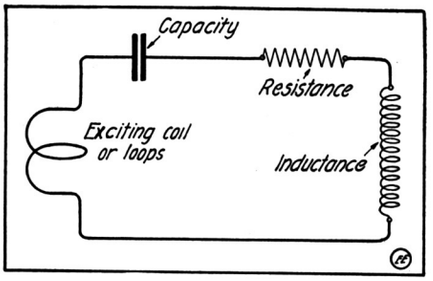
$$Pb\,(C_2H_3O_2) + Na_2\,Cr\,O_4 = Pb\,Cr\,O_4 + 2(Na\,C_2\,H_3\,O_2)$$

PHANTOM ANTENNA.

(865.) Paul Heffle, Detroit, Mich., inquires:

Q. 1. Is it possible to operate a telegraph system by the use of a buzzer, water pipe and gas pipe as current lines?

A. 1. Yes. We advise you to refer to page 318 of the September, 1917, issue of this magazine.



Circuit of a "Phantom" Antenna, Used in Testing Radio Transmitters in the Laboratory.

Q. 2. What are *phantom antennae* and how are they made up?

A. 2. A phantom antenna is an artificial antenna which is used in laboratories in-

stead of a real antenna, but which has the same electrical unit values as that of a real antenna. Thus a real antenna has resistance, capacity and inductance.

You can build one of these phantom antennae by connecting in series a suitable resistance, capacity and inductance coil and the diagram here gives the hook-up of such an antenna. The Government however forbids its use during the duration of the war.

TRANSIENT ELECTRIC PHENOMENA.

(866.) A. Wolf, St. Paul, Minn., asks:

Q. 1. What are transient currents?

A. 1. According to the definition given by Dr. Louis Cohen in his elaborate book on alternating currents, the following holds true: "If the electrical conditions of a circuit are disturbed in any way, as for instance by change of the electrical constants of the circuit, or a change in the electromotive force acting on the circuit, a readjustment of the current and potential in the circuit will necessarily follow. The permanent state, however, is not reached instantaneously; it requires an appreciable time interval before the electrical equilibrium is again establisht. The electrical phenomena which occur in the time interval before the permanent state is reached again have been properly designated *Transient Electric Phenomena.*"

PERMANENT MAGNET AND AUDION CIRCUIT.

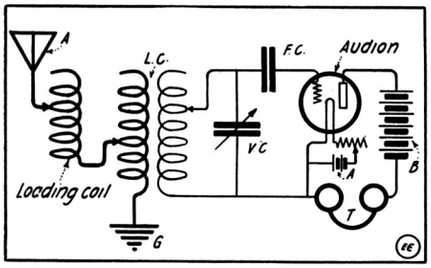
(867.) E. Davis, of Edgewood, R. I., wishes to know:

Q. 1. How can a permanent magnet be used in an Audion circuit to increase the sensitiveness of the device?

A. 1. There is only one possible place wherein a permanent magnet can be utilized in an Audion circuit to advantage, and that is by placing the poles of the magnet near the Audion tube, in which case the sensitiveness of the device is increased manifold, the action of which is due to the concentration of the ionic stream which is discharged by the hot cathode filament. In this case the amplification and rectification of the instrument is considerably increased.

3,000-MILE RECEIVING OUTFIT.

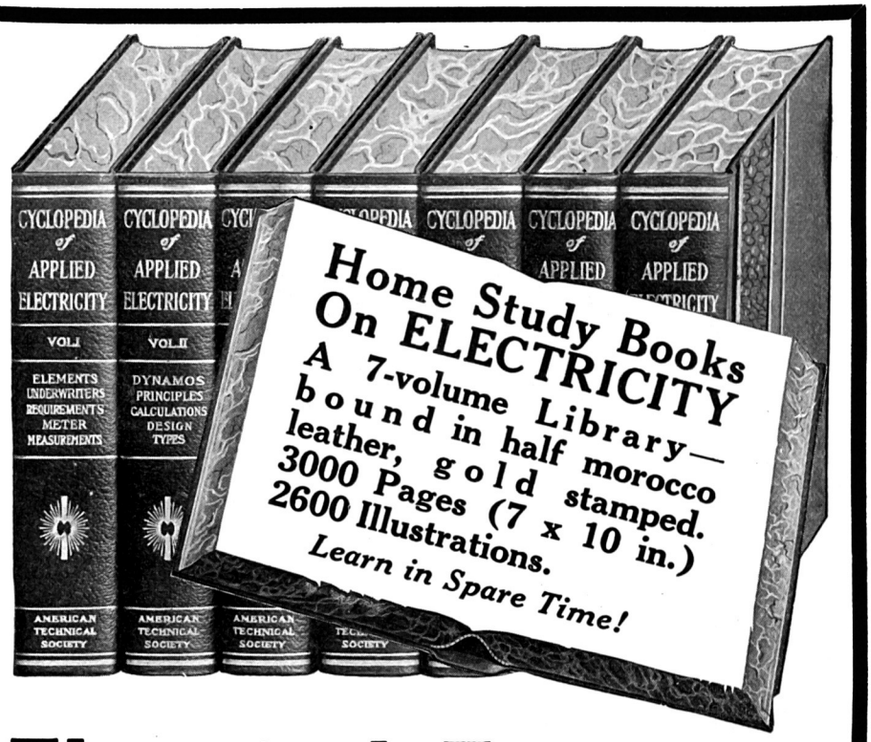
(868.) T. A. Snyder, of Chicago. Ill., asks:



Hook-Up for Audion Receiving Set for Radio-Telegraphy.

Q. 1. In order that I may receive from a distance of 3,000 miles, what wireless instruments are required for an efficient set?

A. 1. The following instruments will be required in order to be able to receive 3,000 miles. A very sensitive detector, such as the Audion, with its accessories, including a high tension or "B" battery; a filament battery; a pair of high resistance (preferably 3,000 ohms) 'phones; a "grid" condenser of .00015 mfd; a .001 mfd., variable air dielectric condenser. A loose coupler of the switch-contact type, and a loading coil.



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MescoTelegraph Practice Set

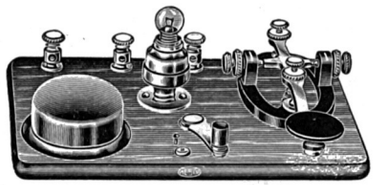
For Learning Telegraph Codes

The Practice Set comprises a regular telegraph key, without circuit breaker, a special high pitch buzzer, one cell Red Seal Dry Battery, and four feet of green silk covered flexible cord.

The key and buzzer are mounted on a highly finished wood base, and three nickel plated binding posts are so connected that the set may be used for five different purposes.

List No. Price
342. Telegraph Practice Set, with Battery and Cord.....$2.70

MESCO Combination Practice Set for learning the Morse and Continental Visual and Audible Codes



This outfit is the only reliable instrument which will enable students to become proficient operators in the U. S. Naval Service, because it is equipped with a buzzer and miniature lamp enabling the user to master both the visual and audible signals quickly.

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Q. 2. How would you connect them?

A. 2. Wiring diagram is given herewith.

Q. 3. Do you know of any firm who sells blue-prints—giving full information as to how wireless instruments can be made?

A. 3. We would suggest that you procure the two books—one entitled "How to Make Wireless Receiving Apparatus" and the other "How to Make Wireless Transmitting Apparatus," which can be obtained from our Book Department at 25 cents each.

SOLID ELECTROLYTE.

(869.) Stanley Dewsnap of Springfield, Mass., wishes to know:

Q. 1. Can you give me the formula for making the solid electrolyte now in use in small portable storage cells in connection with pyrometers of the optical type?

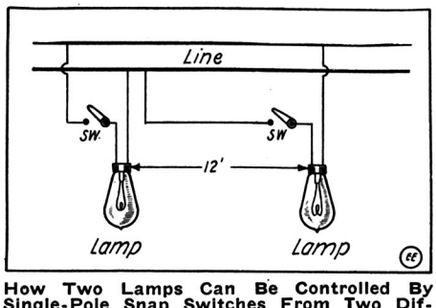
A. 1. The type of storage battery you speak of, and which is used in the pyrometer, is a dry storage battery of the portable type. It can be readily made by immersing the regular storage battery plates in some glass wool which is thoroly saturated with the regular sulfuric acid solution of the proper density. This mixture for making a storage battery of the dry form, has been utilized abroad with great success.

Q. 2. Does the use of such an electrolyte require any different type of plate?

A. 2. The use of this electrolyte does not necessitate a different type of storage battery plate.

RECTIFIERS.

(870.) William Lewis, Rosedale, Kansas City, Kan., writes:



How Two Lamps Can Be Controlled By Single-Pole Snap Switches From Two Different Locations.

Q. 1. Please show in a diagram how I can control two electric lamps (12 ft. apart) by one pole (one circuit) snap switches, one switch upstairs, and one switch downstairs.

A. 1. We give herewith wiring diagram of the scheme in question.

Q. 2. How many rectifier jars are needed to change 110 volts 5 amp. A.C. into 55 volts D.C.?

A. 2. You require four standard type rectifiers in order to obtain the current you desire.

PHOSPHORESCENT PAINT.

(871.) Edw. L. Wagner, of Sandpoint, Idaho, asks:

Q. 1. What is the composition (electrolyte and depolarizer) of the "Radio" or "Tungsten" flashlight battery?

A. 1. The chemical composition of the depolarizer as used in these flashlight batteries is the commercial form of manganese dioxid. The electrolyte is composed usually of a mixture of zinc chloride and sal ammoniac in water. This is used in these batteries the same as the regular dry cells.

Q. 2. How to prepare phosphorescent paint from calcium sulfid?

A. 2. The phosphorescent paint used today is made by thoroly mixing some phosphorescent calcium sulfid with linseed oil.

(*Continued on page* 557)

WANTED! RECRUITS FOR "GAS AND FLAME" REGIMENT.

(This statement is authorized by Major Atkisson of the Thirtieth Engineers).

THE ELECTRICAL EXPERIMENTER has been called upon by the commanding officer of the Thirtieth Engineers to help in mobilizing the personnel of a "Gas and Flame" Service Regiment. This regiment is being recruited now from men volunteering for the service, and will be ready to go "over there" by Thanksgiving.

This is a regiment for skilled, practical men, who will be called upon at once to demonstrate their worth and skill.

Enlistment in the "Gas and Flame" Regiment offers opportunity to skilled men, to be used and recognized as men skilled in their trade.

This opportunity should appeal to men who have previously felt that they were most needed at home, because of their special training and experience.

The regiment will be required in the field of operation to supervise the American offensive in "Gas and Flame" service, and will be called upon to instruct men all along the front in this most important work. Consequently these men, all volunteers, will be in the thick of the greatest activities.

The Thirtieth "Engineers" is the pioneer regiment in the "Gas and Flame" service. Men who enlist now will be leaders in the Spring offensive.

Your Opportunity—This organization will require a large proportion of men able to assume responsibility, and to act upon their own initiative and individual judgment. There will be opportunities to advance to the higher non-commissioned grades. There will be opportunities for commissions.

The "Gas and Flame" service offers a real chance for red-blooded Americans to get in where their efforts will give definite results. In addition to needing any men who are looking for just this opportunity to help put across the important service, specialists are needed as outlined below.

Who Can Qualify—Chemists (analytical, research and manufacturing). Chemical workers, powdermen, men experienced in gas manufacture, machinists, automobile repair men, men able to operate and repair gas or steam engines, pipe fitters, electricians, designers, interpreters, carpenters, blacksmiths, plumbers, boiler-makers and chauffeurs.

Men with long experience in their trade are especially desired to fill the Master Engineer grades.

All men enlisted in the Thirtieth must have good muscular development and be capable of undergoing active service at the front.

Men are wanted who know how to take care of themselves, who are active, energetic, and have a strong determination to carry out any mission to which they may be detailed.

Loyal American citizens with the above qualifications between 18 and 40 years of age, who have not actually been called by a local board in the draft, are eligible for enlistment.

Officers Are Specialists—Colonel A. A. Fries, Engineers, N. A., is to be the commanding officer of the Thirtieth Engineers. He is a regular officer of the corps of engineers, with many years' experience in military and civil engineering. Colonel Fries is now in France and is "Chief of the Gas Service."

Major E. J. Atkisson, Corps of Engineers, is organizing the first battalion of the Thirtieth Engineers at Camp American University, D. C. He is a graduate of West Point and of Cornell University.

(*Continued on page* 558)

QUESTION BOX.

(*Continued from page* 556)

The proportions between these two chemicals is dependent upon the amount of light desired to be emitted by the phosphorescent mixture.

SYNCHRONOUS GAP.

(872.) Robert D. Stewart of Cambridge, Wis., asks the following questions:

Q. 1. What should be the number of cycles delivered by a rotary converter of ½ K. W. to convert 110 volts D. C. to 80 volts A. C., best suited to wireless purposes?

A. 1. We should advise that 500 cycles should be the most efficient frequency for such a rotary converter to be used in radio work.

Q. 2. How can the number of cycles of a rotary converter of such a type be increased to twice the number?

A. 2. The frequency can be doubled in a rotary converter by doubling the speed of the armature.

Q. 3. Which would be the most efficient to use, a synchronous spark gap, or a rotary spark gap, with such a rotary converter?

A. 3. A synchronous spark gap is the most efficient form of spark discharger for use in radio work, and if a rotary disc with projecting electrodes is mounted on the shaft of a rotary converter, a synchronous spark is thus obtained.

MULTI-LAYER COIL.

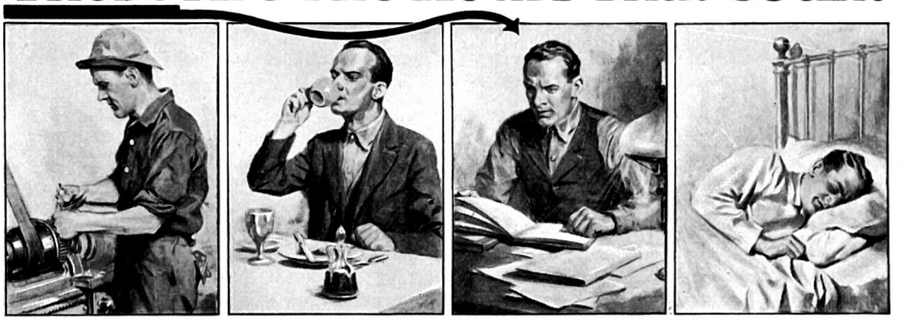
(873.) Mr. B. A. Browne of Washington, D. C., writes:

Q. 1. I understand from the article "Calculation and Measurement of Inductance" on page 320 of the September issue of the ELECTRICAL EXPERIMENTER, that the multilayer coil as described in figures 2, 3 and 4, may be used in lieu of a loose coupler. If I am correct, will you please say how the wave length is varied. The description does not seem to provide for any taps as in loose coupler construction. This coil is described as "very satisfactory for tuning long waves." Will you please give the approximate minimum and maximum wave lengths that could be received with a coil of this design, constructed as indicated on page 321, column 1.

A. 1. The amount of inductance of multilayer coils is varied in the same way as in other types; that is, by taking from each layer a contact lead which naturally controls the number of turns in the coil; thus controlling the wave length or the circuit in which the coil is connected. You can have as many contact leads or "taps" from a multilayer coil as you wish. However, it should be carefully noted that the insulation between the connection and its adjacent layer should be very thoroly arranged; thus avoiding any short-circuits. The maximum and minimum wave length received with such coils is entirely dependent upon the other constants entering into the oscillatory circuit, viz., the antenna inductance and antenna capacity, and the capacity used across the oscillatory circuit. It is essential that these factors be known beforehand, before we can give the maximum or minimum wave lengths that can be had with this type of coil. However, you can obtain wave lengths ranging from 100 to 10,000 meters with this coil, providing the proper capacities are used in the circuit.

Q. 2. I understand from reading the ELECTRICAL EXPERIMENTER that a "tickler coil" is merely a contrivance to rapidly make and break a wireless circuit. If I am cor-

These Are The Hours That Count



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☐ Mechanical Draftsman	☐ DESIGNER
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☐ Gas Engineer	☐ Stenographer and Typist
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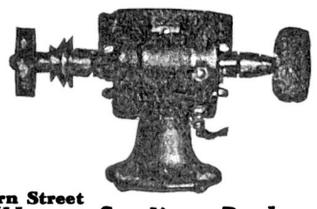

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rect in this, will you tell me how this operation enables the reception of undamped waves with detectors that will not otherwise render such waves audible?

A. 2. The exact function of the tickler coil is given in Query No. 861, and is that a direct magnetic coupling between the wing and grid circuit of the Electron relay or Audion tube is obtained, which functions serve as the means of transferring the plate current to the wing circuit, which grid current is strengthened by the addition of a charge on the grid; thus increasing the amplifying or regenerative effect of the tube. The only means by which oscillating conditions can be had is by coupling both of these circuits and the tickler coil together. In other words, energy transferred and retransferred from both of these circuits, and the rapidity of this transformation of energy is so high, that an oscillatory current of high frequency is obtained, which must occur in the "beat" reception of undamped waves.

WOMAN WINS WIRELESS TEST.

It fell to a young woman to make the highest average at a government examination for wireless operators. She made the highest of anybody—man or woman—in Baltimore city.

Immediately after the declaration of war with Germany ten pretty girls decided to take up wireless telegraphy in order that they might be able to take the places of the boys called to serve their country at the front. They all now have a government license, and one of them received the highest average made.

WANTED! RECRUITS FOR "GAS AND FLAME" REGIMENT.

(*Continued from page* 556)

All officers have been carefully selected from the Regular Army and from civil life, with a view to their special fitness for this particular service. They are experienced chemical, gas and military engineers.

How to Enlist—Go to the nearest recruiting station or U. S. District Engineering Office, state fully and clearly your qualifications and that you wish to be enlisted in the Thirtieth Regiment of Engineers (Gas and Flame).

The officer in charge will examine you physically and pass upon your qualifications

If accepted, you will be enlisted and immediately sent to headquarters of the Thirtieth Regiment of Engineers at Camp American University, D. C.

All men must first enlist as privates, the rate of pay being $33.00 per month and expenses. Men with the necessary experience may be assigned to special duties and given non-commissioned rank at rates of pay ranging from $40.20 to $96.00 per month and expenses. The latter include, for both privates and non-commissioned officers, food, clothing, medical attendance and transportation. Those who enlist will be eligible immediately for promotion, according to their ability and as openings occur. Men who enlist now will have excellent opportunities for promotion as the service expands.

Everybody Can Help—

1. If not qualified for enlistment, get at least one man to volunteer. You can be an immense help in this way, even if you yourself are not in a position to serve.

2. Get this announcement printed in your local newspapers. *This is exceedingly important.*

3. Manufacturers, see that a few men of your organization respond to this call.

4. Use this page as a poster in your office, or ask us for reprints.

EXPERIMENTAL CHEMISTRY.

(*Continued from page* 550)

Again, suppose we want to know how much oxygen will combine with a piece of charcoal weighing 7 grams? Also how much Carbon dioxid (CO_2) will form? Arrange and solve as follows:

$$\begin{array}{rcl} C + 2O & = & CO_2 \\ 12 + 2x16 & = & 12 + 2x16 \\ 12 + 32 & = & 44 \\ 7 \quad x & & y \end{array}$$

$$\begin{array}{lllll} 12 : 7 :: 32 : x & \qquad & 12 : 7 :: 44 : y \\ 12x = 224 & & 12y = 308 \\ x = 18.66 & & y = 25.66 \end{array}$$

Thus 18.66 grams of Oxygen are required and 25.66 grams of Carbon dioxid (CO_2) are formed.

Always have the final weight numbers (as 12, 14, 32, 44 as above) on the same horizontal line; and be sure your equation balances; then it is only necessary to use such numbers as the equation calls for. Results must be given in decimals to one or two places—not in common fractions.

Suppose we want to obtain 2 liters of Oxygen. How many grams of Potassium Chlorat ($KClO_3$) must we employ, if a liter of oxygen weighs 1.43 grams? This question may be solved as follows:

$$\begin{array}{rcl} KClO_3 & = & \\ 39 + 35 + 48 & = & 39 + 45 + 3O \\ 122 & & 74 \qquad 48 \\ x & & \end{array}$$

Weight of O required,
1.43 g. x 2 = 2.86 g.

$$122 : x :: 48 : 2.86$$
$$48x = 248.92$$
$$x = 5.18$$

In working out problems according to the preceding models, observe the following order:

1. Write and balance up the equation.
2. Affix the weights to such of the substances as are called for.
3. Put in the proper places under the given weights, the weights to be used, placing x, y, or z for the wanted substances.
4. Make a proportion, using the substances involved.
5. Place the product of the means equal to that of the extremes.
6. Find the value of x, y, or z.

EXPERIMENT NO. 108. Illustrating the Law of Conservation of Matter. (Quantitative.)

Have 2 test tubes and wind a fine copper wire around the neck of each, leaving a loop to hang them from one arm of a hornpan or other balance. Arrange the balance so that it can be easily adjusted; then pour into one tube 5 cc. of a solution of lead nitrat ($Pb(NO_3)_2$), and into the other an equal volume of sodium chlorid solution (common salt), the exact amount is not essential in either case. Be sure there is no liquid on the outside of the tubes. Fasten the tubes to the bottom of one beam of the scales (See Fig. 93) and weigh the tubes and their contents, or counterbalance them, noting the weight.

Now carefully detach the tubes, pour the contents of one into the other without spilling, note the effect produced, and then hang them again on the beam. In case there is not equilibrium, try the work over again with more care.

Here we have two factors to begin with, *i. e.*, a solution of lead nitrat and a solution of salt. These will be found to have a certain weight, when weighed or counterbalanced upon the scales. These are then mixed and a chemical change is effected.

$$\underset{\text{(factors)}}{Pb(NO_3)_2 + 2NaCl} = \underset{\text{(products)}}{PbCl_2 + 2NaNO_3}$$

Count the atoms in each substance, and see if they are balanced on each side of the equation. When the small $_2$ is placed after the brackets, as in lead nitrat, it means that both the elements within them must be multiplied by two. When a 2 is placed before a substance, as in sodium chlorid, it means that all the elements following it (not beyond a plus or equality sign) must be multiplied by two.

TABLE.

INTERNATIONAL ATOMIC WEIGHTS

The following is a complete list of the 81 elements, with symbols and atomic weights, in which 0 = 16, H = 1.008.

ELEMENT.	SYMBOL.	ATOMIC WEIGHT.
Aluminum	Al	27.1
Antimony	Sb	120.2
Argon	A	39.9
Arsenic	As	74.96
Barium	Ba	137.37
Berylium	Be	9.1
Bismuth	Bi	208.0
Boron	B	11.0
Bromin	Br	79.92
Cadmium	Cd	112.40
Caesium	Cs	132.81
Calcium	Ca	40.09
Carbon	C	12.00
Cerium	Ce	140.25
Chlorin	Cl	35.46
Chromium	Cr	52.0
Cobalt	Co	58.97
Columbium	Cb	93.5
Copper	Cu	63.57
Dyprosium	Dy	162.5
Erbium	Er	167.4
Europium	Eu	152.0
Fluorine	F	19.0
Gadolinum	Gd	157.3
Gallium	Ga	69.9
Germanium	Ge	72.5
Gold	Au	197.2
Helium	He	4.0
Hydrogen	H	1.008
Indium	In	114.8
Iodin	I	126.92
Iridium	Ir	193.1
Iron	Fe	55.85
Krypton	Kr	83.0
Lanthanum	La	139.0
Lead	Pb	207.10
Lithium	Li	7.00
Lutecium	Lu	174.0
Magnesium	Mg	24.32
Manganese	Mn	54.93
Mercury	Hg	200.0
Molybdenum	Mo	96.0
Neodymium	Nd	144.3
Neon	Ne	20.0
Nickel	Ni	58.68
Nitrogen	N	14.01
Osmium	Os	190.9
Oxygen	O	16.00
Palladium	Pd	106.7
Phosphorus	P	31.0
Platinum	Pt	195.2
Potassium	K	39.10
Praseodymium	Pr	140.6
Radium	Ra	226.4
Rhodium	Rh	102.9
Rubidium	Rb	85.45
Ruthenium	Ru	101.7
Samarium	Sa	150.4
Scandium	Sc	44.1
Selenium	Se	79.2
Silicon	Si	28.3
Silver	Ag	107.88
Sodium	Na	23.00
Strontium	Sr	87.62
Sulfur	S	32.07
Tantalum	Ta	181.0
Tellurium	Te	127.5
Terbium	Tb	159.2
Thallium	Tl	204.0
Thorium	Th	232.42
Thulium	Tm	168.5
Tin	Sn	119.0
Titanium	Ti	48.1
Tungsten	W	184.0
Uranium	U	238.5
Vanadium	V	51.0
Xenon	Xe	130.7
Ytterbium (Neoytterbium)	Yb	172.0
Yttrium	Yt	89.0
Zinc	Zn	65.37
Zirconium	Zr.	90.6

EXPERIMENT NO. 109. Illustrating the Law of Fixt Weight. (Quantitative.)

Have 2 graduated burettes arranged as in Fig. 94. Have one of these nearly filled with very dilute Hydrochloric acid (HCl) (C. P. acid with about 10 times its volume of water). Into the other pour approximately the same volume of sodium hydroxid solution (NaOH). This solution can be made by dissolving 5 grams of Caustic soda

(*Continued on page* 571)

DOES YOUR **STOMACH BALK?**

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ARE you afraid of it? Is it a mystery? What do you know about it? What service is it giving you? You are no stronger than your stomach! Your capacity for work, your endurance, your mental keenness, are all dependent upon whether your stomach functions soundly and does its share in producing pure blood for the heart to send to all parts of the body, energizing the mind, and putting "Pep" in every thought and action.

DOES YOUR HEART MURMUR, SKIP AND FLUTTER?

Do you know that your heart is also menaced by a deranged stomach? If, instead of properly digesting your food, it is allowed to remain in the stomach to sour and ferment, the gases thus generated by the decomposition will swell your abdominal region unnaturally, interfering with all the organs, and bringing the pressure thus caused principally against the heart. It is this condition that is responsible for many of the fatal, so-called cases of Heart Failure.

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This is where my study of anatomy and the internal organs becomes so valuable. I have devised methods which bring about such an internal muscular development so that the functioning can be controlled, thus giving you full control of your health.

It is not what you eat, but what you are able to digest that gives you the vitality to do things. Stop pampering your stomach. It is the STRONGFORT Methods that you need, based on the true principles of Nature's laws of health and body building.

I AM A BUILDER OF MEN

YOUR whole body can be rebuilt, I will show you how to help Nature and replace the old worn, decaying cell life and rebuild it with new vital tissue. No matter what your weakness may be, whether it has been brought on by *indigestion, gassy stomach, nervousness,* or by *youthful indiscretions,* my natural methods will correct it. If you are SKINNY, run down, bilious, always tired and sleepy, have headaches, rupture, no "Pep," you need the STRONGFORT Methods. Every bodily ill gives way to the gentle, healing and building influences of my System. Mark the ailment that interests you most on the coupon below, and I will send you personal information that will help you.

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..Short Wind	..Poor Memory
..Flat Chest	..Flat Feet
..Colds	..Increased Height
..Catarrh	..Muscular Development
..Poor Circulation	..Great Strength
..Heartweakness	..Weight Lifting
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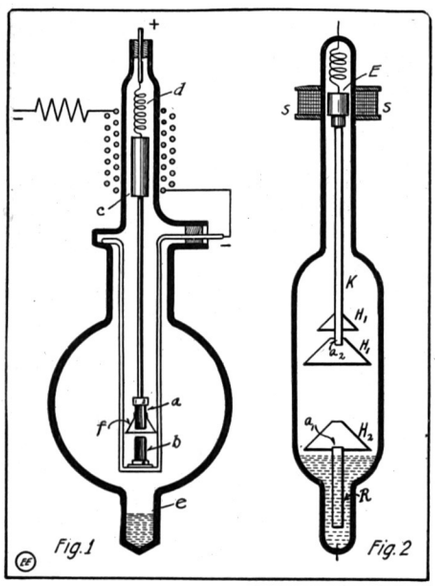
A NEW NERNST VAPOR LAMP.

Prof. W. Nernst describes a vapor lamp in recent German patents which is somewhat similar to Darrah's lamp, and is a decided improvement from the point of view of efficiency.

According to the patent, the lamp includes a spherical bulb, as shown in Fig. 1, which contains the two carbons *a* and *b*. The upper electrode is connected to the iron core of a solenoid, *c*, which is suitably protected against the chemical effects of the vapor. The lower end of the spherical bulb ends in a short closed tubular connection, which contains the salt to be vaporized. The volatilization is effected by an external source of heat; for this purpose the series resistance, to which the lamp is connected, may be suitably used.

In a second patent Prof. Nernst describes a vapor lamp in which the main conducting medium is mercury vapor; a suitable salt is added in order to give a better color to the light. The principle of the lamp consists in adding a line spectrum to that of the mercury vapor; in this way a white light is produced. Mercury vapor, however, has the property of continually removing any foreign substances. It is, therefore, possible to introduce the coloring substance continuously, if such



A New Form of Vapor Lamp In Which a Salt or Mercury Is Vaporized by Electrical Heat.

substances are used as fuse at the temperature of the mercury vapor lamp. The substances thus continuously volatilize with the mercury, subsequently condensing and flowing back into the circuit in order to begin a fresh cycle of operations. In Fig. 2 this lamp is shown, consisting of a glass bulb containing the electrodes. The anode is of mercury, and the cathode consists of a small carbon, *K*, which is connected to the core of a solenoid. It is necessary to prevent the condensed drops of mercury and salt from reaching the arc, and therefore small conical pieces of glass are fused into the vessel, and surround the carbon. The falling drops then volatilize on the surface of the mercury. Another conical glass piece is placed above the mercury in order to lead the vapor to the arc. If a strong current passes, the mercury vapor rises rapidly from the arc, and this causes a sucking movement at the lower ends, which takes a sufficient quantity of the salt vapors with it. A specially suitable salt mixture for these lamps is said to consist of 70 per cent. zinc chlorid, 15 per cent. calcium chlorid, 5 per cent. thallium chlorid, 5 per cent. lithium chlorid and 5 per cent. caesium chlorid. A lamp of this kind without a series resistance gives a light of 3,000 hefner c.p. on 120 volts; it takes 4 amperes, and therefore has an efficiency of 0.16 watt per hefner candlepower, which is a considerable improvement on other electric lamps. The numbers of the German patents are 288,228 and 288,229.

MANY GENIUSES ARE NEVER REWARDED.

By Dr. Leonard Keene Hirshberg, A.B., M.A., M.D. (Johns Hopkins Univ.)

CONSIDERING the relatively poor salaries Uncle Sam pays in Washington, the Government certainly has made some splendid investments—not to say obtained bargains—in many of its employees.

Almost from the beginning of the Government it has been the general rule that a department employee who made an invention need not turn it over to the department with which he was associated. In the Department of Agriculture this is one of the established rules, and the War and the Navy Departments also have promulgated a similar regulation. But, despite all this, it is the unwritten law—which is more powerful than that on the statute books—that a Government employee shall not make money out of his inventions. The Government and the people at large, therefore, reap a valuable harvest of inventions each year which cost them nothing and add immeasurably to the public wealth and comfort.

One of these inventors is Dr. Marion Dorset, biochemist of the Bureau of Animal Industry. He is the man who first isolated the germ that is responsible for cholera in the hog. Then he invented a serum to combat it. Dr. Dorset protected his processes by patents and then turned them over to the public. But anyone who chooses is at liberty to manufacture and use this serum without paying a penny of tribute. It is an absolute anti-toxin. It is estimated that this discovery of Dr. Dorset's is saving the nation about $15,000,000 a year in the one branch of its food supply.

Dr. Dorset is also the inventor of a secret ink used by the Government in stamping meats that have been past upon by the Federal inspectors in the packing houses. Prior to Dr. Dorset's discovery the Government was paying a private firm $60,000 a year for metal tags for the same purpose. The ink is far more effective, for it puts the stamp into the meat itself. It cannot be transferred. Dr. Dorset receives a salary of $3,500 a year.

The problem of grain standardization used to be considered almost impossible of solution. But a year ago J. W. T. Duvel, one of the Government's experts, discovered that there was a variation in the weight of grain of from 5 to 25 per cent., due to the amount of moisture it contained. This was a very important matter, because grain grown in a damp country would have an advantage of about 20 per cent. over grain grown in a dry climate. Dr. Duvel's researches resulted in his inventing a moisture tester, by which the percentage of humidity in grain can be ascertained in a very few minutes. This invention is now in use in every grain elevator in America. Not a cent in royalties is paid to anyone for it.

The Government sends out about 70,000,000 packets of seed a year. It used to cost the Government $1.32 a thousand for the mechanical work of filling these packets with seed. J. E. W. Tracy, of the Bureau of Plant Industry, invented a device for the filling of these packets. This has reduced the cost of this work by about one-fourth and saves the Government a good many thousand dollars a year. It also saves the seedsmen a lot of money, for the machinery can be made and used by anyone without paying a penny for tribute.

Logan W. Page, director of the office of good roads in the Department of Agriculture, gave to the world not long ago an invention of a waterproof cement, which is of great structural value in the building of locks and dams. It has played an important part in the construction of the Panama Canal. It is so valuable to many large industries that its inventor could have sold it easily for a great sum of money. A cement is produced that will make an otherwise porous structure watertight. Floors covered with this cement are damp-proof.

"Dedicated to the Public" are the four words printed at the head of the patents issued three years ago to Major George Owen Squier, Chief Signal Officer of the Army Signal Corps. His invention is revolutionizing the existing system of telephone communications. He might have sold it for a vast sum, but he gave it to the world for nothing.

The value of many of the great inventions of the officers of the War and Navy Departments can be actually proved only when the nation comes in contact with some other power. One of the most important of these inventions that has been given outright to the United States is the disappearing gun carriage. This was invented by Generals Buffington and Crozier.

Major O. M. Lissak of the regular army is the inventor of a machine for the manufacture of cartridge clips. This machine has been in use in the Government arsenals for many years. It is estimated that it has saved the Government something like $40,000 a year. Major Lissak derived no benefit from his invention until about nine years ago, when a bill was introduced in Congress awarding him a lump sum of $25,000.

In the General Land Office there is a chief clerk named Frank Bond. He is a geographer and takes a deep interest in American exploration. Long ago he conceived the idea that a map that would show at a glance just what the early explorers had done would be of great interest and value. Nothing of the sort was in existence. Mr. Bond spent years in making this map, which is of great historical value. It became especially important when some changes were made in the official maps involving the boundaries of the territory included in the Louisiana purchase. Then it was found that Bond's original researches were far more authoritative and exact than any that had been made before. As an aid to the study of the development and exploration of the United States, Mr. Bond's map has been of so much value that it has been asked for by practically every school and library in the United States.

The forecasting of the rise and fall of the tides at thousands of different places is a very complicated and intricate process. It is one of the important parts of the work done by the Coast and Geodetic Survey. Nineteen different elements enter into each calculation. Figuring this out

with paper and pencil used to be a tremendous task. It required an expense for clerical labor that came to about $40,000 a year.

Thirty years ago William Farrell, an employee of the Coast and Geodetic Survey, devised a machine for this purpose. He turned this invention over to the Government, and it has been used ever since. He never has received any revenue from it. The machine automatically figures the time and degree of maximum and minimum tides at any moment of the day or night and at any place along the coast of the United States. It takes only one man to operate it.

In the Treasury Department at Washington there is an ingenious apparatus which mechanically enumerates paper money in a fraction of time required for counting by hand. It is the recent invention of a mechanical expert of that department, and, like all other devices, is free for public use. It is being extensively adopted by banks and business houses.

THE DETECTION OF SUBMARINES.

At the present time it is of the highest importance that those capable of assisting in the problem of detecting enemy submarines should know something of the difficulties that must be overcome and the conditions under which the submarines usually operate. In this connection the following memorandum, which has been publisht in the "Mining and Scientific Press," of San Francisco, by the American Committee of Engineers in London should be useful.

The Engineering Committee of the National Research Council issues the following data to guide those desirous of helping to circumvent the enemy's submarine campaign by means of invention and suggestion. Any communication on the subject should be addrest to Mr. W. F. Durand, vice-chairman of the Committee, at Washington, D. C.

Submarines operate singly or in groups, as may seem best suited to local or special conditions.

They are supposed, where circumstances favor, to lie on the bottom at rest and with listening devices attempt to detect the approach of vessels. On receipt of evidence that a vessel is approaching they rise to a level permitting observation with periscope, and then maneuver accordingly. When in water too deep to permit lying on bottom the submarine must maintain steerage way in order to hold its level of submergence. The minimum speed at which this can be done will range with circumstances from 2 to 4 knots. The maximum depth of submergence is about 200 ft. The usual depth of running is from 50 ft. to 100 ft.

They have been supposed to return to the home base at intervals of 30 to 35 days. The total radius of action will presumably range from 5,000 to 8,000 miles at a moderate cruising speed of 10 or 11 knots. The high speed emerged will range from 14 to 18 knots, or possibly more in latest designs. The maximum submerged speed is about 10 knots.

The time required from emergence to submergence will range from one to three or four minutes, according to circumstances. When submerged near the surface, the time required to raise the periscope, take a quick observation and lower it again, may range from 15 to 30 seconds. If desired, the submarine can follow an undulating path, rising and submerging alternately, at frequent intervals, at will. Or otherwise it may run fully submerged but near the surface, and take frequent observations thru the periscope. Modern submarines are provided

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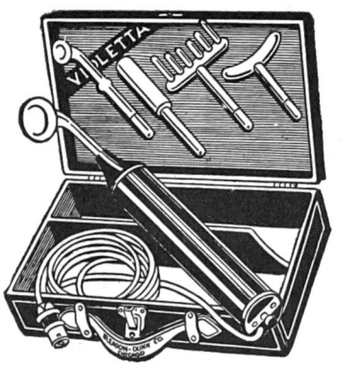

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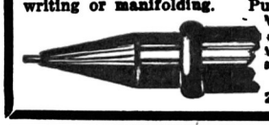

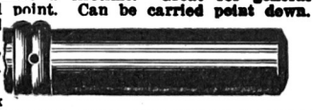

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with two or three periscopes. The loss or destruction of one, therefore, will not necessarily disable the boat.

Torpedoes fired from submarines are presumably aimed by changing the direction of the boat. This, however, is not assured in all cases. The torpedo, in order to run true, must travel at an immersion of about 10 ft. In smooth water it may be run at a shallower depth than in rough water.

Submarines may operate at night with less liability of detection, but with, of course, greater difficulty in picking up their target.

Submarines use the gyroscopic compass.

Sounds produced by the movement of a submarine thru the water, including those traceable to the propeller, to movements of the rudder, etc., should permit of detection by the use of the modern refined sound detecting devices.

The distance at which a protecting net, plate or shield or other means of exploding the torpedo before reaching the side of the ship must be located in order that such distance will render the effect of the torpedo harmless, will depend primarily upon (1) weight of explosive charge, (2) depth of torpedo when exploded, (3) strength of the ship's structure. With modern torpedoes and a depth of 10 ft. or 12 ft., and with the structure of modern merchant ships, distances of 20 ft. or 30 ft. would perhaps be required in order to give good assurance against injury. With rough water and possibly much less submergence at the time of explosion, reduced distances of 15 ft. or 20 ft. might prove sufficient. Experimental investigations on this subject show a very wide divergence among the results, and no precise rule can be given. It may be added, however, that naval constructors generally are satisfied that the distance at which protecting plates or shields would have to be placed in order to secure immunity is so great as to render their use of very doubtful practicability.

GOVERNMENT WANTS RADIO MEN.

Orders were received at the Topeka, Kansas, naval recruiting office recently authorizing the recruiting officer to enlist men and boys, who have completed the high school course or its equivalent, in the radio naval reserve corps.

There are 100 vacancies to be filled from this district. The men accepted for this service will be sent to one of the state universities on the eastern coast, where they will receive a four months' training in wireless telegraphy.

A number of the state universities in the east have offered their equipment in this department and have given the services of their instructors to the government for this purpose. Upon the completion of the four months' course the applicants will be assigned to duty on board a man-of-war. They will be honorably discharged from further duty upon the termination of hostilities.

RADIO PLANT FOR ANNAPOLIS

Annapolis will soon have a wireless station as powerful as that at Arlington.

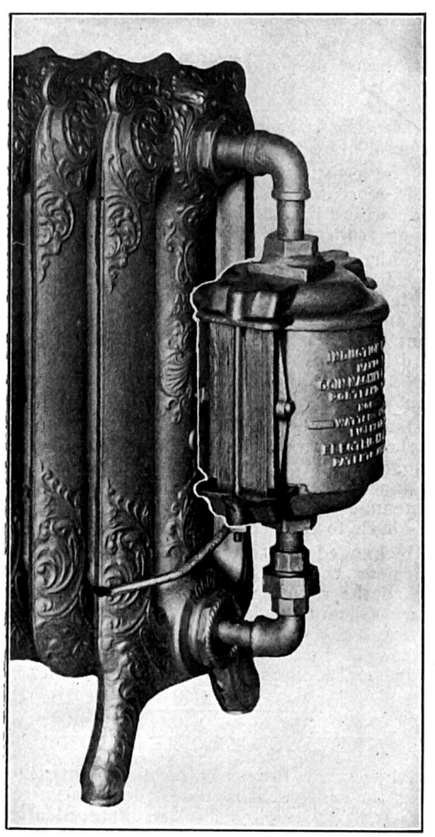
A high naval official admitted recently that the money for the erection of this monster radio station, approximating not less than $1,000,000, has already been set aside and that the work of installing the tower and its equipment will commence at once on the Naval Academy grounds.

AN "INDUCTION" ELECTRIC WATER HEATER.

The induction electric water heater here illustrated, is made in sizes from 750 watts to 500 K. W. In previous heaters of this type, the power factor has been so low as to make them of no commercial value. In this appliance, however, the power factor has been brought to between 75% and 80%.

The heater consists of a cast iron core thru which the fluid to be heated passes, laminated "U" shaped sections surrounding the ends of the core on two sides and a circulating primary coil thru which the exciting current passes, the whole being enclosed by a suitable casing.

The induced energy has been found by test to be wholly due to hysteresis and eddy currents in the solid cast iron core, which in turn heats the fluid of a circulating system into which the heater is introduced. In the resistance type of heater, there is always a chance that the



This Induction Electric Water Heater Is Intended for Use on Radiators, etc. It Involves the Use of a Coil Thru Which A. C. Passes, Which Causes a Water Heating Member to Become Heated by the Current Induced in It.

resistance will burn out. This generally happens sooner or later, and when it does the only thing to do is to get a new heater or heating element. The induction heater, on the other hand, is practically indestructible, the primary coil being of such large size wire that there is no danger of it burning out. Pure asbestos insulation is used thruout which cannot deteriorate with age or heat. The properties of cast iron are such that just before the metal becomes heated to the point of deformation, it loses its magnetic qualities, thus being automatically self-protecting. After cooling, the iron again crystallizes and has all of its former magnetic properties.

In recently investigated cases where the induction heater has replaced gas, it was found that at $4.00 per K.W. per month (4 mills per watt), it was about one-third less than gas at $1.00 per thousand feet.

The engineering principles involved in the construction of this heater do not limit its application to simply supplying hot water for household use, but it can, with very little change, be applied to hot water and steam heating. Where hot water or steam systems are already installed, it is only necessary to connect the heater in place of the boiler.

After a careful investigation, it is found that each kilowatt of capacity in induction electric heaters will supply 20 sq. ft. of hot water radiation. For low pressure steam heating one kilowatt will supply 12½ sq. ft. of radiation.

Further, the induction principle here involved applies itself efficiently to a melting pot for the Linotype and other type casting machines.

SOME DISCOVERIES NOT MADE BY TEUTONS.

During the last few months I have heard the Germans arraigned as blatant, boorish, barbaric, writes Townes R. Leigh in the *Cincinnati Enquirer*, yet in nearly every case the speakers suffixed to their invectives such an expression as: *"But when it comes to brains you will have to hand it to them; they have made science."*

Why hand it to them? What epoch-making invention or discovery is of German origin, except a stamp on which is inscribed "Made in Germany?" The steam engine has been called the greatest of all inventions. It broke the shackles from slaves; it mingled the marts of the world; it made neighbors of the antipodes. Newcomen, a native of Devonshire, England, obtained the patent for the first partially successful steam engine; Watt, a Scotchman, perfected it; Cuynet, Murdock and Trevithick brought forward the locomotive, not on German soil; Stephenson, an Englishman, was the first to apply the locomotive steam engines to railways for passenger traffic; France, England and America applied it to navigation.

The telegraph, which brings us the daily history of the world, was invented by an American, Professor Morse, who also suggested the Atlantic cable, which was subsequently laid by that American merchant-scientist, Cyrus W. Field, assisted in "mooring the new world alongside of the old" by Lord Kelvin, the prince of physicists, a British subject. Alexander Graham Bell, the inventor of the really practical telephone, was born in Scotland and grew to fame in America. A young Italian, Marconi, gave commercial wireless telegraphy to the world.

Cyrus McCormick, a native of West Virginia, produced the reaping machine which harvests the food of the world; Meikle, of England, brought forth the thrashing machine; thus was famine banished. Eli Whitney of Massachusetts parentage, invented the cotton gin; Hargraves, an Englishman, made the spinning jenny; Arkwright, also English, supplied its deficiency with his famous spinning frame; the Englishman Kay, introduced the fly shuttle in weaving; Brunel, who devised the knitting machine and Cartwright, inventor of the power loom, were British subjects. Thus was the world clothed.

Altho Germany is militaristic and worships at the shrine of Mars, what votive offering has she made to the God of war? It was not she who contributed gunpowder, smokeless powder, percussion cap, nitro-glycerin, guncotton, dynamite, tor-

(*Continued on page* 566)

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Easily built with our finished parts, without using lathe and with few tools. Learn the construction of a gasolene motor by assembling it yourself.

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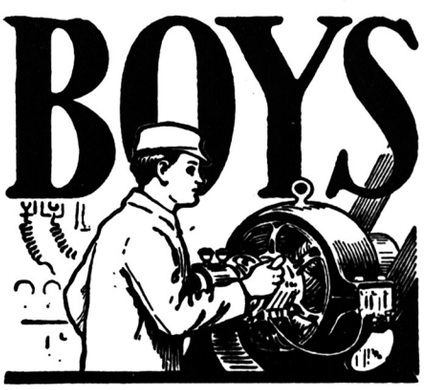

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The electrical industries offer wonderful opportunities to boys with a liking for Electricity. The salaries paid to trained men are large, promotion comes rapidly and, best of all, the work is fascinating.

The discovery and development of new lines (such as wireless telegraphy and telephony), from time to time, promise attractive and paying fields to those who wish to specialize. The *will to do* and *Special Training* will bring success to *you.*

The International Correspondence Schools can help you to become an expert in electrical work, no matter what branch you like best. Thousands of young men have already won success through I. C. S. help. You can do as well as anybody, *if you try.* Everything is made so clear that you can learn in your spare time, regardless of where you live or what your work. No books to buy.

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TWO NOVEL ELECTRIC INSPECTION LAMPS.

The small automatic inspection lamp here shown in use has been brought out by a Boston inventor, for use especially by physicians and dentists. This lamp consists of an extremely small battery case and lamp holder to which is attached a wooden tongue depressor. When in use the pressure of the tongue on the depressor actuates the switch element, lighting the lamp; when removed from the mouth the depressor automatically opens the lamp circuit.

One of the Latest Electric Mouth Inspection Lamps Intended for Dentists and Physicians. It Carries a Tongue Depressor.

This lamp is equipt with 100 interchangeable wooden tongue depressors, and takes the regular pencil battery. By its use the physician has the free use of one hand, as it only requires one hand to hold the lamp and tongue depressor combined, and the construction allows it to be so held, that the hand does not obstruct the view of the throat.

The same inventor has perfected the small lamp and magnet shown in the accompanying illustration, and which is intended for use about automobiles and other machinery to pick up small metal parts that cannot be reached by the hand. The magnet end of this device is provided with a 110-volt, 4 candlepower bulb for illuminating the part inspected or the location where a piece of metal is to be picked up. The outfit is 18 inches long and provided with a suitable length of cord which can be attached to any lighting socket. The magnet part is detachable, so that the lamp can be used alone when such use is desirable.

WHY SOME KISSES THRILL!

An eminent psychopath has likened a kiss to the stroking of a cat, and says that the longer you kiss the same woman the less thrill you get in return.

Love is an electro-chemical action, and he who says the same effect that is derived from a kiss can be obtained from the stroking of a cat is a theorist, and is taking into consideration only the electro part of the action. It is likely that the learned psychopath is not a man from the great school of experience, or that he has never been fortunate enough to come in contact with the human magnet that did not repel him.

Compare two human beings, male and female, with two large storage batteries highly charged. The action to which the batteries are subjected wears them out as time goes on. They work harmoniously, and so it is with a man and a woman. So long as she is magnetic she draws the man to her, and the same thrill is there; but once she begins to repel, then the magnet ceases to perform its functions and the thrill is gone.

Who would be satisfied to stroke the back of a pretty cat to bring about the thrill they have experienced when brought in contact with the magnet that attracted them?

When the chemical elements in a man and a woman blend properly that is when they are mated; the kiss never loses its thrill.

Chicago Herald.

We showed the above clipping to our office boy, "Fips," and asked him for his opinion, he being self-admittedly well versed and experienced in all matters (and manners) of osculation.

After "Fips" had digested the clipping by means of two bottles of dyspepsia tablets, he scratched his tousled red head thoughtfully with his lower-most hind leg, and after partaking a fresh slice of "Raremint" chew-chew gum, he spake thusly:

"Everything being electrical in this world, why not the kiss? Does it not tingle like a galvanic current? Is there, as a rule, not a lot of juice behind it? Does it not require a good deal of pressure (voltage)? Does it not often result in a shock—when SHE "pastes" you one on your "lamps," in other words, when the fuse blows out?!

But from an academic standpoint the kiss really is a direct short-circuit of passion—neat definition that, what? I might add that the kiss also very often acts as a sort of electrical safety valve. Take two highly charged human animals, man+, woman—; if the potential was allowed to rise indefinitely either individual might blow up. Hence nature in its wisdom provided the kiss, which acting as a safety valve, neutralizes the + and — electricities, by allowing both currents to surge back and forward thru the valves, *i.e.*, lips. If one application does not bring down the potential to the safety level, why, dog-gone it, switch 'er on some more!!

The *Chicago Herald's* critic, however, picked out an unfortunate example when he compared man and woman to "large" storage batteries. Did not the poor simp know that storage batteries contain ACID? How can they—man and woman—be expected to "work harmoniously" when they are full of sulfuric acid?! My, my! How can a kiss survive a constant acid bath? No wonder the thrill becomes less and less! No wonder that sooner or later a "galvanic internal action" sets in, reducing the current strength to almost zero! And what about those internal short-circuits, present in all storage cells, particularly in human ones: selfishness, distrust, disloyalty, disinterestedness, dissatisfaction?

These not only completely discharge the storage battery, but make it often impossible to ever recharge the cells again, just as in a real storage battery. The plates have become thoroly sulfated by this time, covered with a thick coating. Result: the human animal by this time has become entirely and hopelessly callous. Hence, if a kiss is ever attempted in this state, no current can flow—consequently no thrill.

Moral: If you *must* kiss,—Stroke a cat!

MIND READING BY WIRELESS.

While traveling in Ohio last year, writes a commercial telegrapher, I attended a performance in a small town, where a mind reader was giving a wonderful exhibition of his powers. The mind reader, apparently an Oriental, for he wore a turban and spoke broken English, was able to name every object the audience chose to select for a test; he also named dates on coins, words, and read passages in books and newspapers; it was a marvelous exhibition.

The mind reader's assistant had a familiar look; he reminded me of a telegraph operator I had worked with in the West. When he came to where I was sitting I noticed he kept one hand in his side coat pocket. The assistant asked me to give the mind reader a test.

Pulling out my Union card, I asked him to name the organization of which I was a member. It was three minutes by my watch before the mind reader answered, "Brotherhood of Railroad Signalmen."

The assistant turned away from me as he held my card in such a way as to bring the side where his hand was in the coat pocket away from me.

Thirty years as a telegrapher has made my hearing wonderfully acute and I detected faint Morse signals. Then I realized in an instant why the mind reader's assistant kept his hand in his coat pocket. He had a wireless buzzer in there and was signaling the mind reader. The buzzer was muffled with cloth to kill the sound.

I also saw why the mind reader wore a turban and stood rigid in one position on a rug. The turban was to hide the receivers clamped on his ears and the rug to hide the antennae that ran under it and up behind his back to the receivers.

I changed my seat several times so as to be near the assistant; and every time I heard the same faint Morse signals. How the assistant glared at me every time I changed my seat! Finally I winked at him, and walked out of the theatre. He gave me a grateful look as I past out of the door.

WIRELESS AT THE FRONT.

Altho very little has been permitted to pass the censors, it is understood that wireless is being employed to an unprecedented degree on the battle front in Italy. In the front line trenches the aerial wires are strung along a parapet just behind the barricade. In the support trenches the aerial wires are elevated a few feet above the ground, while far to the rear the aerial is generally elevated to about twenty feet by light bamboo poles. The sectional masts familiar to our Army pack sets and wagon sets are practically unknown in the war zone, for the reason that a modest aerial a few feet above the ground is sufficient for the short ranges which must be covered. Wireless telegraphy is a necessity in communication work, because of the difficulty of laying telephone and telegraph lines and then maintaining them across shell-sprayed terrain.

SOLDIERS AND SAILORS!!!

Write us now and then when the spirit moves you. A few words from you telling of life "in the service" may be the means of attracting many valuable recruits.

LEARN THE CODE WITH THE OMNIGRAPH

The Omnigraph Automatic Transmitter will teach you the Continental and the Morse Codes, *at home,* in *half the usual time* and at the least possible expense.

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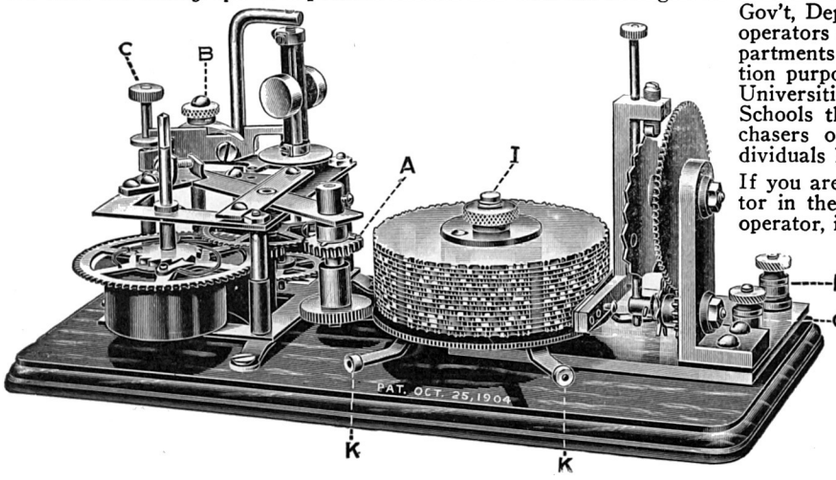

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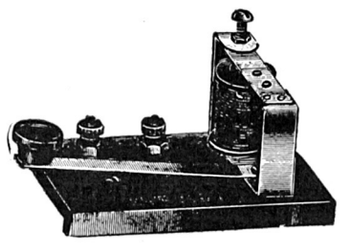

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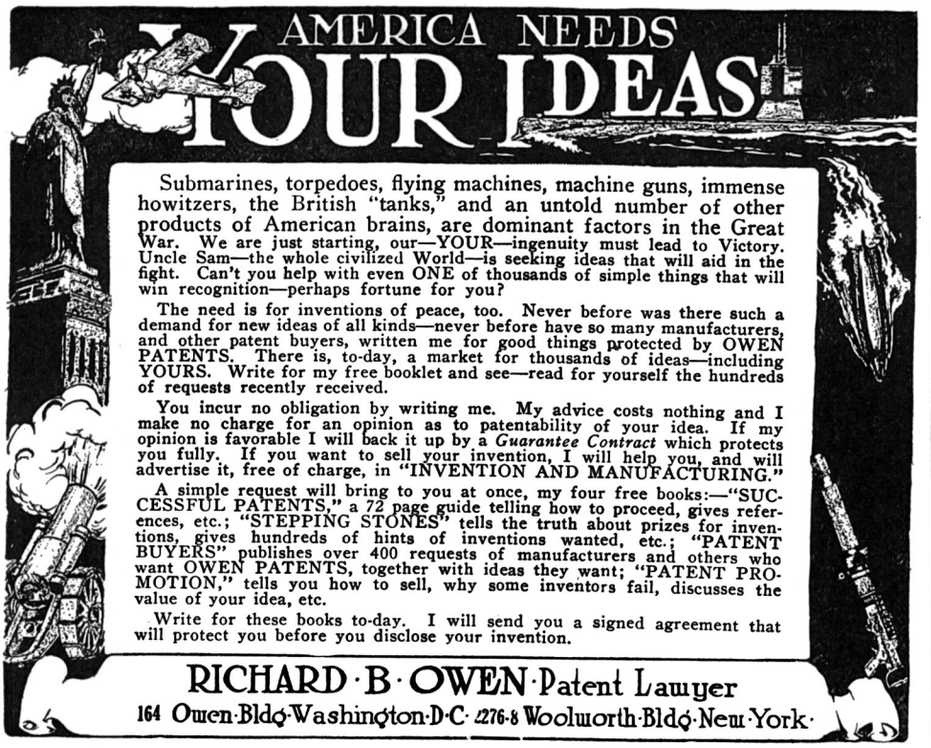

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NECK-TIE.

(181.) Carleton A. Howiler, Akron, O., submits an illustration and description of a four-in-hand tie which does not need to be tied by hand. It contains a certain device whereby it is possible to put it in place very quickly thereby constituting a considerable saving of time.

A. The idea is quite good and as original as it is probably new. The point however is: how many men would wish to wear a tie of this kind? Still we do not wish to condemn the idea on account of this, as there are certainly a great many men who would gladly buy such a tie. We think patent protection can be had on this device, but as a precautionary measure, would advise our correspondent to get in touch with a patent attorney first.

ELECTRIC WIND SHIELD.

(182.) Norman J. Shoffer, Norwich, Conn., has devised a wind shield for automobiles which is heated in a certain manner by electrical means, the idea being to heat the wind shield in order to keep the glass warm thus melting the snow; it will also turn the rain into steam.

A. This is a very good idea, and seems to us rather practical if certain means could be incorporated in the device, which we shall be glad to give our correspondent if he desires them.

As sent in to us in its original form the device is not entirely "fool-proof."

ELECTRICAL MINE.

(183.) Paul Brooks, Milton, Pa., has submitted to us an idea of a wirelessly controlled land mine to be planted by troops and which mine is to be used only when the troops are forced to retreat. In that case the mines will be exploded under the enemy thereby impeding his progress. A clever tuning device has been included in this invention.

A. This is a good idea, and inasmuch as our correspondent also took care to safeguard the mine so that it could not be blown up accidently, we think that it might possibly be adopted by some of the warring nations. A device of this kind could be used as a trap by ordering the troops to make a feint retreat, thereby annihilating the advancing enemy's troops, after which the land could be occupied again by the original forces. We advise to have patent attorney look into the patent question, as we are not quite certain that this particular invention does not infringe with a similar one that came to our notice not long ago.

MAIL TIME SAVER.

(184.) Rudolph Goldstone, Connellsville, Pa., submits an idea of an electrical device to be incorporated in a rural mail box, the idea being that as soon as the letter is deposited, a bell will ring in the distant house thereby announcing that mail is in the box.

A. While this is not a new idea, and while a great many patents had been taken

ADVICE

H. GERNSBACK.

is of interest to inventors and particularly to Phases. Regular inquiries addrest to "Patent charge. Such inquiries are publisht here for the be of importance, we make it a rule not to as far as it is possible to do so.
charge of $1.00 is made for each question. plicit. Only one side of sheet should be writ-

out on similar devices, we think the one submitted to us has some possibilities, but before applying for a patent, we would advise our correspondent to have a search made in the patent office for patentability.

HEAT CONTROLLED FAN.

(185.) Francis Ziesse, Brooklyn, N. Y., has submitted to us description and illustration of a highly ingenious electric fan attachment, the idea being that by means of a certain adjustment the fan will start revolving as soon as the temperature reaches a certain point. In other words, on a very hot day when you are too busy to pay attention to the heat, the fan will not forget about it, but will start revolving on its own accord when the room becomes hot enough.

A. This certainly is a capital idea and while the device as submitted by our correspondent is good, it is perhaps not quite as practical as it might be. We think that if some of the features are modified, a commercial proposition can be readily obtained. We think a device of this kind is patentable.

OSCILLATION TRANSFORMER.

(186.) M. Kent Steddom, Oklahoma City, Okla., submits to us what he calls a "rotating oscillation transformer." The idea is that combining a rotary spark gap with an oscillation transformer in a certain manner.

A. This is certainly a very fine as well as clever idea and we heartily approve of it as it combines two instruments into one. The disposition as well as the arrangement is indeed very ingenious and we think there is no doubt but that good patent protection can be had upon a device of this kind. We have never come across anything quite the same, and our advice to our correspondent is to get in touch with a patent attorney at once.

SOCKET TRANSFORMER.

(187) J. B. Thompson of Paragould, Ark., submits a lamp socket transformer of minute design, which is supposed to be screwed into an ordinary lamp socket and can be used for running lamps, toys, etc.

A. There is nothing unusual in the idea. As a matter of fact, a great many transformers of this kind are on the market at present, several types being made by the General Electric Co.

CINEMATOGRAPHIC DEVICE.

(188) Henry Gruen, New York City, claims to have invented a scouting camera for the purpose of taking cinematographic records of the entire surrounding country or a battlefield, thus substituting an aeroplane and eliminating dangers for aviators. Use is made of a miniature balloon of the Zeppelin type, the apparatus to work by means of electricity from the ground. Our correspondent asks if an invention of this kind has any possibilities, and if it is patentable, etc.

(*Continued on next page*)

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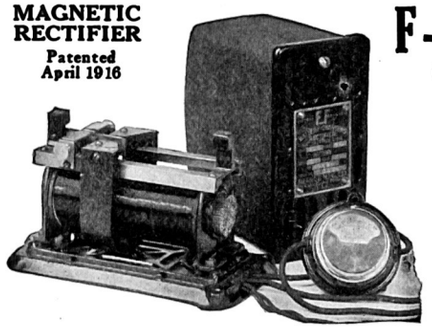

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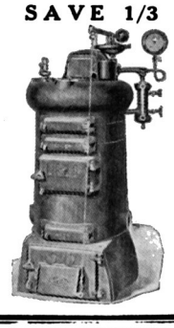

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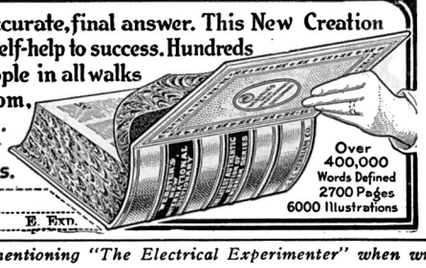

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A. Nothing new is contained in this idea, schemes of this nature having been in use by the Allies as well as by the Central Powers, and sometimes quite good pictures have been obtained. More times, however, the balloons with the camera have been shot down by enemy fire.

SAFETY COAT HANGER.

(189) John F. Bingham of West Toronto, Can., has submitted an idea for an automatic coat and umbrella hanger, making it impossible for an unauthorized person to take either coat or umbrella, the idea of the device being that a coin, say for instance, one-cent or five-cent piece is dropt thru a slot which delivers a key to the patron. Then the coat as well as the umbrella is hung up on the device which automatically closes, and the wearing apparel can then not be taken from the device unless a key opens the lock.

A. This is a really excellent idea, the best part being that it is simple and should be rather cheap to manufacture. This is an important consideration, as for instance, restaurant proprietors would not wish to invest a heavy sum for a device of this kind. To our mind the invention looks original, and we think that little trouble will be had in securing a patent. Our records do not show that anything like it has been patented in the past.

SOME DISCOVERIES NOT MADE BY TEUTONS

(*Continued from page* 563)

pedo, shrapnel, automatic cannon, magazine rifle, breech-loading gun. Gatling gun, revolver, Maxim silencer, hammerless gun, gunboat, ironclad batteries or ship armor plate, revolving turret, submarine or airplane.

Germany did not produce the first aniline dye, vulcanized rubber, liquid gas, gas engine, water gas, thermometer, barometer, piano forte, barbed wire, cut nails, plate glass, circular saw, cable car, electric car, sleeping car, air brake, bicycle, automobile, pneumatic tire, sewing machine, typewriter, calculating machine, cash register, steel writing pen, etc., *ad infinitum*.

The greatest thing that Germany has done, however, is to falsely advertise herself as the light of the world. No son of hers invented the electric light, the gas light, the acetlyene light, the kerosene light, the searchlight, the flashlight, the safety lamp, the candle dip or the friction match. America, France, England and other "untutored" and "unkultured" (sic) nations performed these tasks. The sun, moon and stars are the only lights left for Germany's contention, and according to the Mosaic account, the Lord and not the Kaiser, made and placed them in the firmament.

Daguerre, a Frenchman, presented us with photography. Our own Edison brought forth the motion picture to delight and instruct the eye and the phonograph to please and teach the ear. Galileo, who first saw the heavens with a telescope, was an Italian. The men who first saw the earth and its teeming life with a microscope were not of German origin. By use of the compound microscope, Pasteur, the French biologist, as early as 1857 demonstrated a connection between the microscopic organisms and disease. This was nine years before Dr. Kock, the German bacteriologist had graduated. In this connection the important antiseptic surgery of Dr. Lister, of England, should be recorded. Edward Jenner, the discoverer of

vaccination, and Harvey, the discoverer of the circulation of the blood, were Englishmen. An American taught the world the use of anesthetics. Our dentists excel all others. They are employed by many crowned heads—even the Kaiser has his.

The Teutons have not shown the engineering skill of the French, who cut the Suez Canal, or of the American who joined the Atlantic and the Pacific at Panama. The decimal or metric system by which the Germans make their measurements is a gift from France. The method by which they make their steel is that of Sir Henry Bessemer, of England. Many of the fruits and vegetables of which they eat an enormous quantity were brought forth by our own peerless Burbank.

Lavoisier, the father of modern chemistry, was French. Linnaeus, the founder of botany, was of Swedish origin. To Hutton, of England, we are indebted for geology; to Mary, of Virginia, for the physiography of the sea; to Descartes, of French parentage, for analytical geometry; to Comte, of France, for sociology; to Germany for sauerkraut and pretzels. Her sons did not compose the crew of Magellan's fleet, the first to circumnavigate the globe. A German did not discover the North Pole nor lead the way toward the South Pole.

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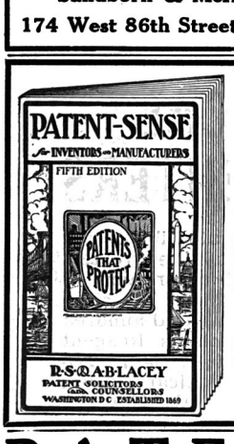

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BOOK REVIEW

WIRING FOR LIGHT AND POWER. By Terrell Croft. Flexible covers, 5 x 7¾ inches, Pocket size, 430 pages, 382 illustrations, price $2.00. Publisht by the McGraw-Hill Book Co., New York City, N. Y., 1917.

The first edition of a most concise and valuable treatise for electrical men, designers and electrical contractors. The aim of the book has been to give all explanations of rules and clauses of the Fire Underwriter's schedule in a clear and up-to-date manner; so that the layman as well as the more advanced and practical man can grasp them quickly.

The work covers all branches of the electrical art; plans are presented for the installation of interior wiring and general lay-outs of the various branch circuits, protecting devices and safe carrying loads. There are a number of chapters on the installation of high and low potential transformers, generators, dynamos and motors with the various best approved methods fully illustrated. Many important hints are given regarding the care and maintenance of equipments, covering storage battery systems, street and interior work, as well as stage equipment, showing the various approved methods of installing switch-boards, border lights, arcs and bunch lights—also the proper protection of these various systems in regard to fire hazard.

A very good idea is incorporated in the work, viz., a list of questions are provided at the end of each chapter covering subject matter on the same, that will act as a review, and thus enable one to commit to memory quite a bit of the work. The book is well edited, strongly bound—being pocket size—convenient to carry around, and should find a place in every student's, electrical contractor's and engineer's library.

THE MECHANICAL WORLD. Electrical Pocket Book for 1917. Cloth bound, 304 pages; size 4¼ x 6¼ inches, illustrated, price 45 cents postpaid. Publisht by Emmott & Co., 65 King St., Manchester, England, The Norman, Remington Co., Baltimore, Md.

A really pocket size and very useful compendium of electricity which should be in the hands of everyone interested in the art whether student or more advanced engineer. The authors have endeavored in this popular work, to cover as much ground as possible in a succinct, yet clear manner. The various chapters cover every branch of the art, starting with the electrical units, giving their definitions and derivations, Laws of Resistance, Arrangements of Batteries, Electrolysis, Magnetic Circuits and Materials, Hysteresis, Eddy Currents, Direct and Alternating Current Motors, Generators, Dynamos, Converters, their installation and care, troubles and how to locate and remedy same, etc. Various methods of wiring are shown and explained, and the means and formulas for calculations, proper sizes of wires, etc.

Chapters are given showing and explaining the latest and best methods for measuring and testing various circuits and apparatus and the instruments necessary for such operations. Some very important new contributions are covered in lengthy sections on Electrical Measurements and Testing. This is a large subject but is thoroly covered by the omission of all theoretical explanations, and the adoption of very concise methods of description and illustration. In another section much practical data is presented in a compact form on Transmission Line Calculation. In the section devoted to Electrical Meters, a note on Mercury Meters has been introduced, while the section on Lighting Circuits and Switching has been greatly revised.

A goodly number of pages have been devoted to useful tables and gages; also charts on square and cubic roots, Logarithms and Anti-logarithms. A novel idea is the diary and memorandum section, enabling one to keep notes from day to day for the entire year.

The authors shall be very pleased to consider practical contributions for future issues which will be paid for at a liberal rate if accepted. Taken all in all the work is thoroly up-to-date and the contents of this issue have been thoroly revised.

PRELIMINARY MATHEMATICS. By Prof. F. E. Austin, E.E. Cloth bound, size 4¾ x 7¼ inches, 169 pages, price $1.20. Publisht by Prof. F. E. Austin—Hanover, N. H., 1917.

A small book but chuck full of a series of problems which will help everyone, be he student or lay reader, to grasp the necessary mathematics and algebra that will enable him to advance in any chosen field of engineering.

While the book has evidently been prepared for

(*Continued on page 573*)

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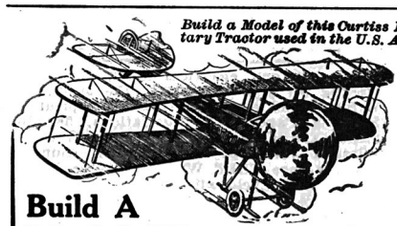

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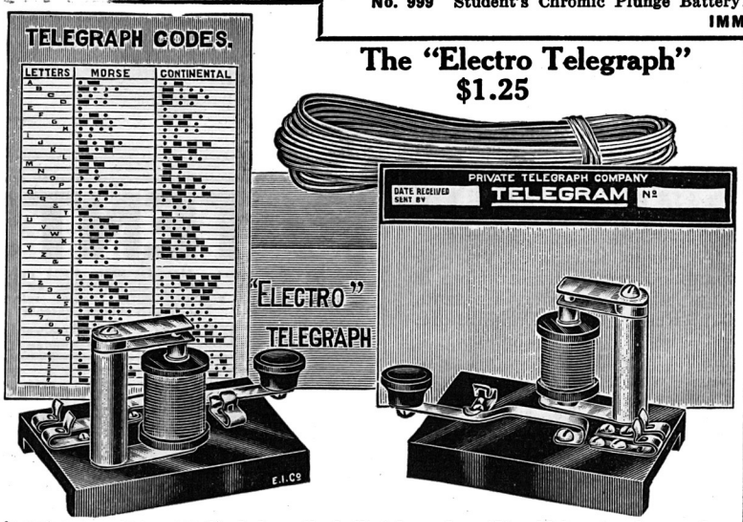

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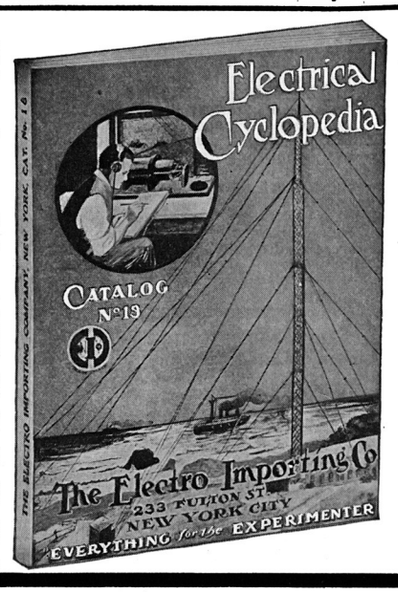

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RADIO ROLL OF HONOR.

(*Continued from page* 533)

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showing the volume of each liquid.

Into a clean, small beaker draw off 10 cc. of NaOH solution. To this add a drop of phenolphthalein solution or a few drops of litmus solution. Now move the beaker under the acid burette and slowly draw into it enough acid to exactly neutralize the alkali. The last portions must be let in drop by drop, with constant stirring. Neutralization is determined by the disappearance of color of the indicator, or the pink tinge in case litmus is used. At that instant stop the flow of acid.

Read the volume of NaOH solution and also of the HCl. Record as follows:—

Volume HCl (first) ....c.c. Volume NaOH Sol. (first) ....c.c.

Ratio of NaOH Sol. to HCl ....

Volume HCl (last) ....c.c. Volume NaOH Sol. (last) ....c.c.

Ratio 1 c.c. NaOH to HCl....

Volume HCl (used) ....c.c. Volume NaOH Sol. (used) ....c.c.

RADIO ROLL OF HONOR

Application for Membership in the Radio League of America

I, THE UNDERSIGNED, a Radio Amateur, am the owner of a Wireless Station described in full in this application. My station has been in use since....., and I herewith desire to apply for membership in the RADIO LEAGUE OF AMERICA. I will abide by all the rules of the LEAGUE, and I particularly pledge my services as a Radio operator, or for Signal Corps duty to the United States Government when called upon.

I understand that this blank with my signature will be sent to the United States Government officials at Washington, who will make a record of my name.

Witnesses to signature:

.....

.....

Name.....

City.....

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Date.....191

Description of My Station and Apparatus

Sending .....

.....

Receiving .....

.....

.....

.....

I can send approximately.....words per minute.

I can receive approximately.....words per minute.

My age is.....years.

.....

.....

.....

.....

(12-17)

EXPERIMENTAL CHEMISTRY.

(*Continued from page* 559)

in 100 cc. of water. Draw off a few drops of liquid from each burette, to get rid of the air at the end.

Take accurate readings of each burette, (reading from the bottom of the meniscus, see Fig. 95), and make records.

NaOH ..... c.c.
HCl ..... c.c.

The experiment might be extended by evaporating the solution and weighing the solid NaCl and computing the weight of the NaCl per 1 cc. of HCl or NaOH solution used.

EXPERIMENT 110. (Quantitative.)

Do this experiment exactly in the same way as the previous one, except first to

(*Continued on page* 577)

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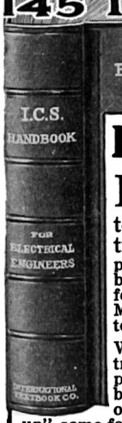

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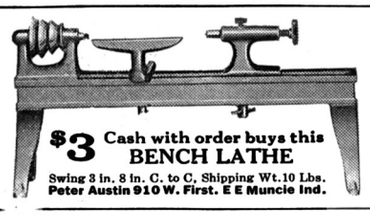
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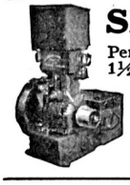
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ELECTRIC EXPORTS ALMOST DOUBLED.

American electric apparatus is gaining rapidly in popularity the world over. A compilation by the National City Bank of New York shows that the value of electric machinery, appliances and instruments exported in the fiscal year 1917 aggregated more than $50,000,000 against $30,000,000 in 1916, $20,000,000 in 1914, and $10,000,000 in 1911.

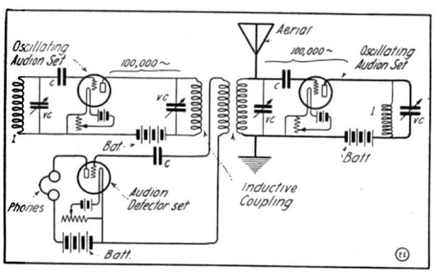
Of the nearly $2,000,000 worth of telephones exported, more than $100,000 worth went to Asia and South America. Nearly $100,000 worth went to Oceania; $300,000 to North America and practically $1,000,000 to Europe, the total telephones being exported in 1917 being twice as great in value as in 1912. Of the nearly $500,000 worth of electric fans exported in 1917, the largest market was in India, Hong Kong, the Straits Settlements, China, Japan and Siam got big shipments.

LOCATING THE SUBMARINE BY RADIO.

(*Continued from page* 510)

it will be heard in the telephone receivers as a distinct sound.

In other words, the beat frequency note giving an audible signal is the difference



Circuits Used in Radio Submarine Detector, as Devised by Mr. Bishop.

between the changed radio frequency oscillations in circuit (1) and those produced in the free oscillator circuit No. 2, which latter is non-radiative, as becomes evident.

In practise the different sets of apparatus are mounted in their respective cabinets and the cabinets moved about on the instrument table until the proper and most desirable inductive relation between them is obtained.

HOW I TELEGRAPH PICTURES.

(*Continued from page* 517)

24,000 revolutions per minute. This is the mechanical difficulty of tele-vision. As to the electrical difficulty, it will suffice to say that a picture requires several thousand variations of light and shade, and at the present stage of electrical development five hundred breaks per second cannot be exceeded over a long line. Animated cartoons should offer no great obstacle, but the problem of tele-vision is to render an object visible at a distance. Several wires, of course, make tele-vision possible, but a practical, one-circuit apparatus would seem to await a more complete knowledge of electricity or of the ether. Tele-vision for short distances may be accomplished with lenses, mirrors and the prism, but the impressions soon become indistinct.

The telegraphing of pictures is a more fruitful field, and as yet it is a comparatively undeveloped art, affording great opportunity to the electrical experimenter.

THE MARVELS OF RADIO-ACTIVITY.

(*Continued from page* 515)

latter from Colorado and Utah. Radium must be regarded as a changing element, its calculated period being several thousand years. Hence, in order that any radium exist in the geologically old minerals, the supply must be kept up by the transformation of some other substance. Since radium is always found in uranium minerals, it is plausible that uranium is the parent element for the derivation of radium. If this is the case in old minerals which are unchanged by the action of underground waters, the ratio of radium to uranium must be constant. This has been shown by several investigators to be true, the quantity of radium being determined by the emanation method previously described and the uranium by chemical analysis.

It is necessary to show, in proving the relation of radium to uranium, that radium appears after some time in a uranium compound previously purified. The first attempts at this were unsuccessful, using periods of a year. It was then decided that some intermediate product was formed between uranium and radium. This was demonstrated by Soddy, who proved that radium does appear in the uranium solution after several years in such quantities as to indicate another slow-period product as intermediary.

Actinium preparations were also found to give rise to a growth of radium, but later researches showed that the radium was not due to the actinium itself but to an associated substance, separated by Boltwood, and called "Ionium." From its calculated period the amount of ionium in uranium minerals must not be less than ten times that of radium, as the amount decaying into radium is one-tenth of its amount to supply the necessary radium. It has not yet been shown that uranium produces ionium, the parent element of radium, but there is no doubt that it does do so.

The constant relation between uranium and radium will hold only for minerals where there has been no opportunity for chemical alteration or removal of any part thru the action of underground waters, or other agencies.

End Products of Change

When the radio-active changes have come to the end, each of the elements uranium, thorium, and actinium should have a final product with a very slow period of transformation, either a known or unknown element. Since an alpha particle's expulsion lowers the atomic weight four units—the atomic weight of helium—the atomic weights of the end products now known can be calculated. For example, uranium gives off two alpha particles, so the atomic weight of ionium is 238.5—8 or 230.5. Radium comes out 226.5, in good accordance with experimental values. Similarly polonium is 210.5, and the final product 206.5. This value is very close to the atomic weight of lead, and so indicates this is the final product from uranium and radium.

Since in old minerals the transformations have taken place for long periods of time, the radio-active material should be accompanied by the end product, if a stable element, in considerable quantities. Boltwood has shown that lead invariably occurs in radio-active minerals, and often in the amount calculated from the uranium content and its age. This problem cannot be definitely settled until it is shown experimentally that radium changes into lead, or better that polonium breaks up into helium and lead. An extremely large amount of polonium would be necessary for this, but several have shown that one of the products of polonium is helium.

(*Continued on page* 578)

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BOOK REVIEW.

(*Continued from page* 569)

the use of those whose educational training has been somewhat limited, it has been so modeled as to adapt itself to the uses of pupils in the first grades of high school and to those desiring to enter college. The work contains a series of examination forms and proper solutions as required for entrance by a number of prominent universities.

Many of the examples and problems presented in the book are original, having been evolved in the process of many years of teaching, and this small book should prove the connecting link between the study of arithmetic and the study of algebra. The work is very thoro from the first stage to the last so far as it goes, and besides having a paragraph on how to study and concentrate, it also contains useful tables pertaining to interest, weights and measures, etc.

The principal aim has been to show practical applications of theory discust, and it should be in every real student's library, whether as a study or reference book. The treatment is such that one does not lose interest in reading the various chapters, as the author has happily combined the charm of applied mathematics with theoretical deductions.

ELECTRIC AND MAGNETIC MEASUREMENTS. By Charles M. Smith, Cloth Bound; 373 pages; 5 x 8 inches; illustrated; price $2.40. The Macmillan Co., New York, N. Y., 1917.

A valuable book to all persons interested in electrical work; especially to students and engineers. The various phases of electrical measurements are treated on very thoroly and the author has succeeded in bringing out many technical points in a popular way, which should appeal particularly to students of the subject.

The book has been developed from a course of lectures and laboratory notes which have been used by students for a number of years. In presenting the work, it is pre-supposed by the author that the reader has a general knowledge of physics and calculus. Much of the material has been gleaned from standard work, and the laboratory exercises are described in such a way that particular types of apparatus are not demanded, unless well-known and generally available.

The various terms are simply defined and everything is so arranged that the student is taken step by step thru the various laboratory experiments, in easy interesting stages.

The work is liberally illustrated with standard diagrams of commercial measurements. The book is unhesitatingly recommended to all students of measuring problems and the general treatment of the work is such that all will be able to grasp the explanations readily.

A TREATISE ON ELECTRICITY. By F. B. Pidduck; Cloth Bound; 640 pages; 6 x 9 inches; Cambridge University Press, England; G. P. Putnam's Sons, New York City, American Representatives. Price $3.60.

The author in this rather advanced work has covered a field highly above the average reader and it is to students of universities, engineers, etcetera, that this work will really appeal.

The general principle has been to cover in one volume the theoretical and practical side of electricity; much space has been saved by omitting detailed treatment of elementary topics. Starting from the beginning, the reader attains the real gist of things, but he must be a good mathematician.

The following are some of the interesting chapters: Mathematics, Permanent Magnetism, Electrostatics, Electric currents and magnetic effects of the same, Magnetism, Induction, Electrolysis, Electric Oscillations, Conduction of Electricity thru Gases, Radio-activity, and the theory of Electrons. Calculations, Curve plotting, standard measurements and other similar topics are only a few of the advanced subjects treated.

The author has dealt in an interesting way with a very dry subject from the layman's point of view, and deserves considerable credit for the excellent manner in which the whole work is covered.

The chapters on "Radio-activity" and "Conduction of Electricity thru Gases" are especially interesting, many important developments of Radium being brought out. In summing up be it said that it is a very worthy volume, well edited, and a book that covers many difficult problems in a new way.

CORRECTION.

The book entitled "Chemistry in the Service of Man," reviewed in the November issue should have been priced at $2.00 instead of $1.60.

WIRELESS STATION AT WILLEMSTAD COMPLETED.

A wireless receiving station has been completed at Willemstad, Curacao, and began operations on October 4. Communication was establisht with various important stations. The newspapers now publish news from Nauen, Germany.

The station at Nauen is the principal distributing point for German wireless propaganda. From this station is sent the service of the Overseas News Agency, which was received at Sayville, N. Y., until the United States entered the war.

HOW TO BUILD A ONE-WATT MOTOR.

(*Continued from page* 545)

Slip the coils over the poles and hold them in place with two small strips of brass bent U-shape and having short right-angle bends at their ends, which press down in between the coil and the pole-piece, but a strip of paper must be put between this brass holder and the coils for there is the possibility of "shorting" the two coils, one to the other. Connect the coils in series and see that they are so hooked up that the current in passing produces a *North* and a *South* pole at the business (armature) ends of the field-poles. This is best done by starting with the end of one coil and see which way the current turns, either clockwise or counter clock-wise and connect the other end to the next coil so that the current still rotates in the same direction.

The last step in construction is the second bearing and this is made entirely of fiber, cut from a piece one-eighth inch thick. This is three-quarters inch long and one-half inch wide and is cut as shown in the drawing. It will be seen that the ends of the two braces are filed a little to fit under the frame-work and a small hole drilled thru frame and fiber, which enables you to force a large size pin thru and lock the bearing to the iron frame. It should be noted that the two braces are placed between the field coils, thereby making the fiber bearing lie at right angles to the brass bearings which of course makes no difference in the final result. For the brush support cut two pieces from the same brass tube that was used for the commutator, about one-quarter inch long and bore holes in the braces just large enough for them to pass thru, but before forcing them into place solder two thin copper strips three thirty-seconds inch wide to them. This is done by cutting a wider strip and boring holes in the ends so that the tubes can pass thru. After soldering cut strip to proper width and bend it somewhat like the sketch, so that when inserted into the fiber brace it rests on the commutator with a light but even tension. The ends of the field coils can be forced

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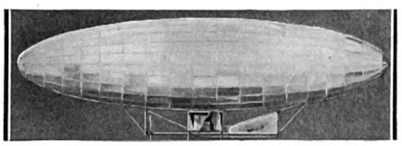

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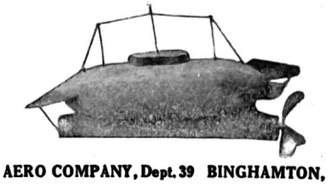

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under the strip where it is soldered to the tube and the tubes themselves act as very good binding posts for the connecting wires from the source of supply, which are merely inserted into them. It may be found that upon testing the motor runs backwards. This can be remedied by reversing the field connections, altho it don't make very much difference if the motor does run in the wrong direction.

The motor is of the shunt type, altho it could be connected for a series type if intended to run on a little higher voltage than one or two volts. As a shunt connected machine I find that it runs very well on one dry cell and draws somewhere in the neighborhood of one-half ampere, more or less. This means that it delivers about one-eight-hundredth of a horse-power and a small fan can be soldered to the end of the shaft so that if the motor cannot be heard, *it can be seen running.* This fan need not be over five-eighths inch in diameter and has four plates; it is cut from thin sheet brass. A small brass case can be made to carry the motor in, for after making one, the temptation to take it on a visit is very strong and one does not want to smash it after the time and labor has been put upon the construction of the machine. I made it in about eighteen hours which is fairly good time for the first one, but of course the second motor ought not to take as long.

Under running conditions I find that with the proper voltage there is very little sparking at the commutator; in fact sparking is not known unless excessive voltage is applied and this is due to the large brushes and small current handled. Just a little drop of vaseline on the bearings helps wonderfully and the motor hums like a Jersey mosquito; it will run for fifteen minutes or more without undue heating. The power developed can be measured by letting the motor wind up a thin thread with pins stuck in it, until just enough pins are used so that the motor can pull them up easily. Then from the exact weight of the thread and pins and the distance they were pulled thru and the time it took to do the work, the fractional horse-power can be determined.

THE HOW AND WHY OF RADIO APPARATUS.

(*Continued from page* 537)

out of one turn, about two-thirds the way down on any ordinary transmitting helix. This results in two distinct windings being formed, as becomes evident; the shorter winding being used as a primary and the longer one as a secondary. The clips can be moved along the coils to vary the coupling as aforementioned.

Fig. 6 shows what is known as the transmitting *variometer.* It is usual to build these non-adjustable as to turns, and the inductance of the instrument is varied by simply moving the two spiral coils nearer to each other or farther apart, as the case may be. When the two coils are brought parallel on the same axis, and when connected as shown in the diagram Fig. 6, then the minimum inductance is obtained for the reason that one coil "bucks" the other or the inductance of coil (2) neutralizes that of coil (1). When the coils are drawn completely apart, their maximum inductance is obtained. The variation of inductance by this means is quite precisional, and the "Telefunken" radio sets utilize this tuning principle to a very large extent.

At Fig. 7 is shown the method of making a continuously variable contact with transmitting inductances. This trolley wheel contactor was first used on Fessenden radio inductances. Some of these, in the larger sizes are built of hollow copper tubing, thru which water runs to carry away the heat, and it is interesting to note in this respect that a hollow tube is fully as efficient as a solid rod, size for size, in radio transmitting inductances. This is so for the reason that the current at these high frequencies, varying from 50,000 to 300,000 cycles or possibly more per second, only penetrate a very slight distance from the surface, due to what is known as the "skin effect." This is the reason why radio transmitting sets are best hooked up with either woven wire ribbon or with a substantial flat copper strip, instead of with a small size round copper wire.

The conical tuning inductance shown at Fig. 8 has come much into favor, during the past few years, and provides one of the most efficient forms of radio frequency inductance there is. The primary as well as the secondary coils are made in conical form as shown, and the coupling is varied by sliding one within the other in the usual manner. The number of turns and the position of the active turns in use in any case is adjustable, as in the previous examples.

The principal advantage of this form of inductance coil is when a small amount of inductance is required only, the operator has the privilege of selecting a number of smaller diameter turns instead of using one or two turns of large diameter, which is less efficient owing to the low flux density in this case. There are several other desirable factors involved in the design of conical inductances, such as the rise in potential by auto-transformer action and means for distributing this more effectively, and the fact that a larger inductance variation in a given space can be obtained, all things considered.

Conical oscillation transformers have been utilized with great success by the National Electric Signaling Company. The advantage of this type of oscillation transformer is that a finer and closer mutual inductance can be obtained, since the movable coil can be placed in closer proximity with that of the stationary one.

One of the most efficient methods of arranging an oscillation transformer, and involving the use of three "pan-cake" inductances is shown at Fig. 9. Usually the center coil or "pan-cake" is connected as the primary, while the two outer movable "pan-cake" coils are connected in series and form the secondary. As the dotted lines indicate the flux distribution with this arrangement is the most efficient in that both or the secondary coils are in active use in a strong field in contradistinction to the usual oscillation transformer of this type, utilizing but two "pan-cake" coils, in which case the coil acting as the secondary is cut by only one half the flux that this one is.

NEW ELECTRIC BOMB DROPPER FOR AEROPLANES.

(*Continued from page* 511)

The other novel features of this invention consist of an electric clock that drops the bombs automatically and a fixt schedule or table arranged for the aviator so that he can tell at a glance how to set the automatic bomb dropper, after he has decided on the altitude from which he will drop his bombs and checked up the speed at which he is flying.

Suppose for example, he decides to drop his bombs at sixteen hundred feet elevation, after checking up his speed by sighting some object several miles before he reaches his objective. In the right hand column of the schedule index, Fig. 4, opposite 1500 feet altitude, he will find the degree or angle at which to fix his telescope, which is given as 35°. As soon as he has located this

object over his sighting bars and then picked up his object on the telescope cross-hairs, he pushes the electric button directly under the clock, the face of which is divided into sixteen seconds and the space between into tenths. This releases the "second" hand and the clock ticks off the seconds; when he is directly over his object he reads the time, and finds he is flying say eighty miles an hour. He then moves the indicator on his schedule to 1,500 feet, 80 miles, and the time is shown directly opposite—eight seconds and nine hundred eighty-two thousands, which should correspond to the time he has just taken to pass over the tangent of his triangle, see Fig. 1, which is the line from C to B, at the 1,500 foot level. At D, the aviator would release his bomb, as a projectile dropt from a moving object is carried along by the momentum for some distance in an arc before its speed is diminished, is attracted by gravity, and starts down on a vertical line. This would have to be checked up by actual test and deducted from the schedule provided.

The triangle, Fig. 1, is formed, first by deciding on the altitude, then fixing the telescope at the proper degree; this second line is variable, according to the altitude determined on. The instant the object shows on the cross-hairs of the telescope the other vertical line B of the triangle is formed and the aeroplane flying at the pre-determined height establishes the third line or tangent, C to B.

The clock mechanism is run by a spring but is controlled by electricity, (see Fig. 7). The "second" hand and "set" hand are insulated and connected on a separate circuit from the starting device; the hands close the circuit, operating the arm of the solenoid and releasing the catch which holds the bomb, when the second hand reaches the set hand. The circuits to the bombs are changed after each bomb is dropt by the switch, (see Figs. 4 and 7), or all are dropt at once as desired.

It is to be noted that with the Lewis device for automatically dropping bombs from air-craft it is only necessary for the bombing officer to take his preliminary sight before he reaches the scene of his activities. Then when he "approaches" the object of attack he turns the sighting telescope to the predetermined angle. Having done this he watches thru the telescope until he spots the building, or other object to be bombed, and as soon as it appears at the intersection of the cross-hairs, he punches the clock release button. The aviator has then nothing further to do: flying at the given altitude, the machine is piloted over the target, at the speed allowed for. As the aeroplane passes over the target (theoretically) the clock hands make contact, actuating the bomb releasing magnet. As already explained the clock would be compensated so as to drop the bomb a short time before the object was reached.

To the extreme left of the instrument is an emergency lever so that if the circuit for any reason should not work, the manual control lever will drop all the bombs together.

At the bottom of the board are arranged four red lights that light automatically as each bomb is dropt. The illustration also shows the arrangement of the bomb shutes in the cockpit of the fuselage. The red lamps indicate the number of bombs that have been dropt or those that remain, so that if the aviator is interrupted in his work, he can tell by looking at his instrument board just how many bombs he has left. The schedule index shown is computed for illustration, the speeds being 60-80-100 miles; while an actual schedule would have to show 60-65-70-75-80-85-90-95-100 and more miles per hour.

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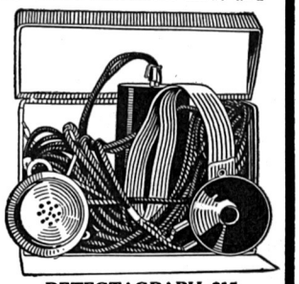

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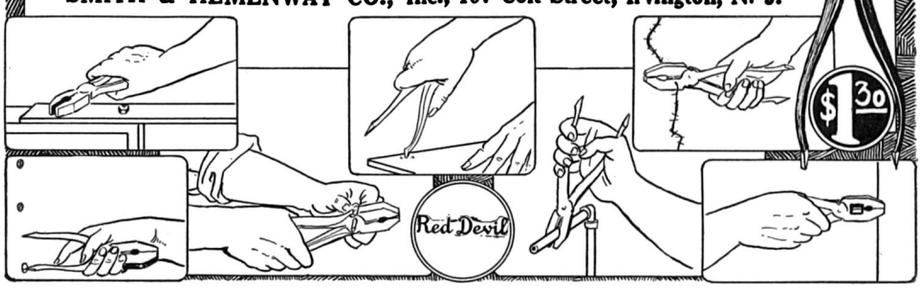

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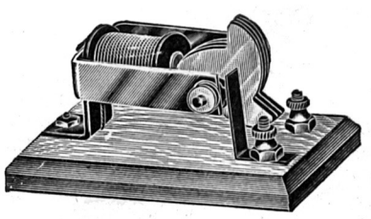

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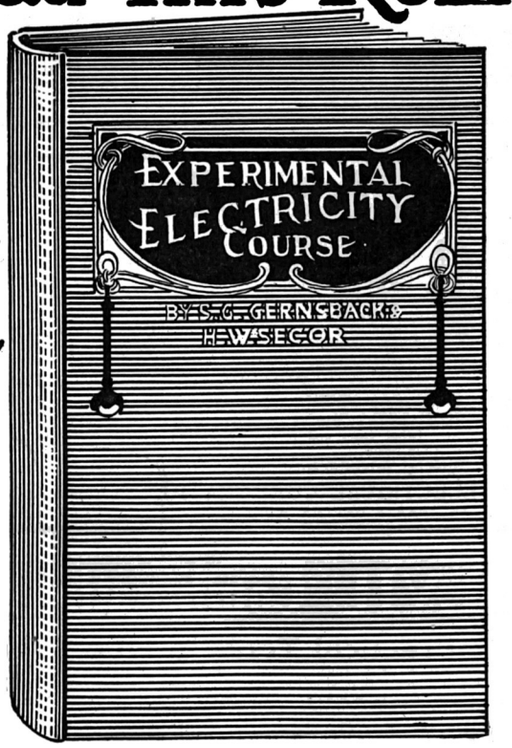

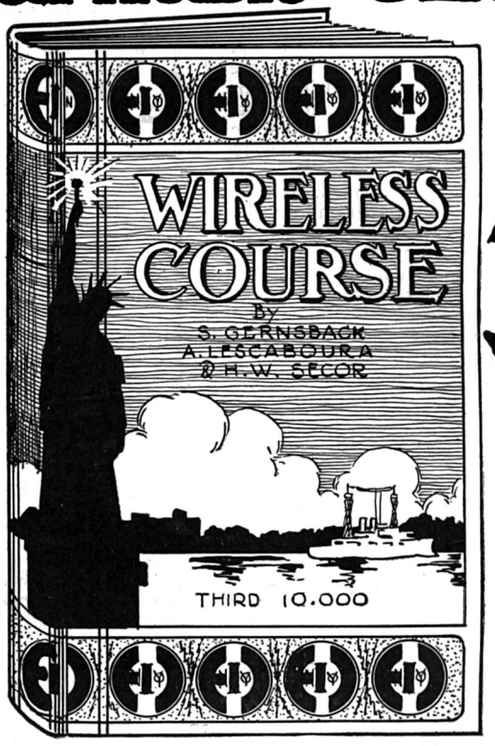

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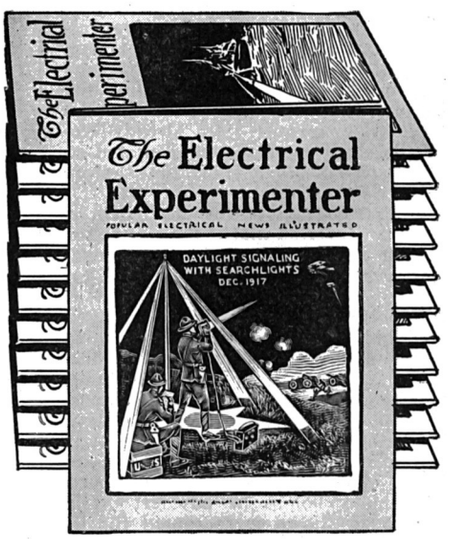

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EXPERIMENTAL CHEMISTRY.

(*Continued from page* 571)

draw into the beaker a different amount of NaOH, say 15 cc., and neutralize that amount. Make records of results as before. Find the ratio of NaOH solution to HCl used, and reduce it to 1 cc. of either the NaOH solution or HCl. Compare this result with that of the previous experiment. Is it approximately the same? If not, repeat it.

EXPERIMENT NO. 111. (Quantitative.)

Make this experiment like the two previous, only start with 20 cc. of NaOH solution. Keep accurate notes. Compare your final results to see whether a unit of NaOH solution combines with approximately the same amount of HCl, or vice versa. If it does it must illustrate a general law, namely the law of fixt weight.

SOME INTERESTING NEW RADIO APPARATUS.

(*Continued from page* 534)

at Fig. 2, is an instrument of wide usefulness. It has a range of 150 to 10,000 meters wave length, the calibration curves being mounted in the lid. It is equipt with hy-tone buzzer, battery in special removable pocket, crystal detector, vacuum tube, 'phones, thermo-couple and galvanometer. The condenser is calibrated and the four inductance coils are wound on Bakelite spools. The exploring coils may be connected by means of a special flexible duplex connector as shown in figure, or may be connected rigidly if desired. Special inductances can be had, giving a higher wave length range.

In the realm of radio transmitting keys, we find the new combined manual and radio relay type shown at Fig. 3, which has a capacity of 5 kilowatts without overheating. This key has been approved for use on Government wireless sets, and possesses among other excellent qualities a very strong hammer action in the opening and closing of the contacts, which are of very substantial character.

One of the most interesting of these new instruments is the "flame-proof" key shown at Fig. 4. This key is intended especially for use on submarines, aeroplanes and dirigible airships, where there is the least possibility of gases being present, and which might be ignited with disastrous results by opening the usual key. As will be seen, this flame-proof key comprises a substantial instrument of the usual pattern, with the exception that the contacts are opened and closed in an air-tight compartment. It is of very substantial design, and will stand a very heavy overload.

The universal wave meter shown at Fig. 5, while not possessing some of the features of the one shown in Fig. 1, is well adapted for all ordinary work, and has the advantage of rather a wide range of wave lengths—200 to 2,600 meters. In its standard form it includes a variable air condenser mounted beneath a Bakelite panel, with a scale engraved with 100 divisions; two inductances for long and short waves—a simple crystal detector mounted upon the panel and a single high-resistance 'phone, with headband. Binding posts are provided for connecting in a sensitive hot wire meter or thermo-couple and galvanometer. For all ordinary purposes, however, the crystal detector and 'phone will be found to fill the requirements. The binding posts are so arranged that the detector may be connected either double or unilateral. The two inductances and 'phone are contained in compartments of the case, which is of oak, while the graph of the wave lengths is fastened in the lid of the case, where it may be read easily. The meter measures 9 by 7½ by 5½ inches, and weighs 7 pounds. It can be furnished with a third inductance to read to 12,000 meters.

An interesting variable step inductor is shown at Fig. 6, and is intended particularly for use in Audion detector circuits, such as those devised by Armstrong. Two or more of these variable step inductor coils may be coupled up in duplicate for use in the Armstrong regenerative circuit.

The receiving variometer shown at Fig. 7, is of interest as these instruments have been accorded more and more recognition in recent years, owing to their fine tuning possibilities. The variometer here shown comprises three coils, which are connected to a special switch, enabling the operator to instantly throw the coil circuits in series or parallel; thus changing the inductance value of the instrument decidedly.

The coils themselves are wound in a self-supporting manner, and are so proportioned in their geometrical and electrical dimensions that the losses in the instrument are extremely small. The apparatus is provided with an accurately graduated dial and indicator, the dial having one hundred divisions. The indicating handle is stationary, while the dial revolves, the latter being rigidly attached to the rotating spindles and knob.

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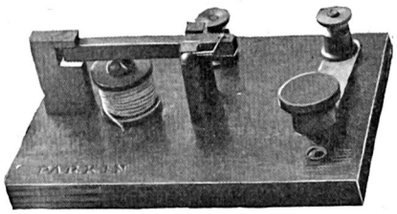

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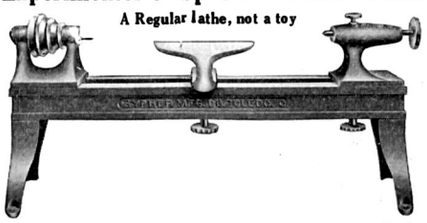

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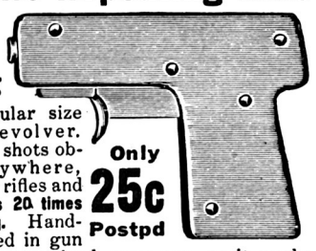

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THE MARVELS OF RADIO-ACTIVITY.

(*Continued from page* 572)

And here we have the much-talked-of modern *alchemy*.

The action of radium on human tissues was unknown until 1901, when Becquerel received his famous burn, fourteen days after carrying a tube of active material in his pocket for several hours. Since that time very active investigation has taken place. Many countries have establisht special laboratories for radium research. The U. S. Government has a large plant in Denver for the extraction of radium from carnotite ore to supply the needs of hospitals and medical laboratories.

The diseases which radium has been applied to, up to the treatments developed during the present war and on which we have no definite data, are papillomata, lupus vulgaris, epithelial tumors, syphilitic ulcers, pigmentary naevi, angromata, and pruitis and chronic itching of the skin. The different varieties of rays used are controlled by the use of screens or filters of lead, silver and aluminum. Radium is analgesic and bactericidal.

Since a large amount of thorium is separated annually from thorium minerals, for use in Welsbach mantles, it would be of great importance at the same time to separate the radiothorium and mesothorium. For many purposes active preparations of these substances would be as valuable as radium itself, and the supply of material would be greatly increased.

Experiments have been carried on as to the effect of radio-active matter on plants, but no definite results have been compiled from the mass of data obtained, and due particularly to the scarcity of material with which to work.

(THE END.)

THE AUDION AND THE "EDISON EFFECT."

(*Continued from page* 536)

direct line of the carbon, no effects were recorded on the galvanometer.

At that time (1884) quite a lengthy discussion took place as to the whys and wherefores of the phenomena thus evolved by Mr. Edison, but be that as it may, we can readily see that the foundation of all present day valves was laid down by Mr. Edison's early experiments with heated and cold electrodes within an evacuated chamber as here described.

Now, we "started something," but these statements are backed up by proofs taken from that time, and to make a long story short, it does not tell us how we "Radiobugs" are going to profit by this discovery. The single, one-step, two-step, waltz or any other brand of Audion won't do us much good, so let's simply hope that some day we may again fish out our "B" batteries and tune up for Nauen or the Eiffel Tower.

THE UNCROWNING OF THE GIM-CRACK KING.

(*Continued from page* 540)

piece to the tail of its predecessor on one of several huge balls of the same. The piece he was handling when I appeared was about four inches long, so I gathered that every little bit was expected to help, as the song goes.

This sight was not what you'd call inflaming with encouragement to one about to propound royalties of ten to fifty dollars per week. Altho string at that time was more expensive than now, it was quite evident that $10.00 would cover Mr. Crowell's savings from this source for the rest of his natural life; and to suggest his parting with it for a single delirious week of advertising seemed distinctly too forward. I forgot the magnificence of his realm upstairs, his standing as a merchant prince, and the large additional profits to accrue to him thru my invention. With a sickening sag, like the breaking of a Ford rear spring, my asking-price dropt to $5.00, and my courage to one degree above zero absolute. In the semi-falsetto of an assumed breeziness, it was all I could do to sputter forth, "M-Mister Crowell, may I show you something interesting?"

Zebediah grudgingly allowed that I might, altho he kept right on with his sorting and tying of the strings. So with shaking fingers I unpacked my big double board, my boat in its separate box, and my two wet-cells.

Oh, those wet-cells! I knew they'd been slopping, because I'd been leaving a trail of drops behind me for some distance; but to my horror I found they'd spilled so much that they would no longer work my motor.

I'd prepared to get along with a hypothetical electric fan; but when I had to explain also, while poking the Mary Ann on her course with my finger, that the gallant craft would, it most surely would go of its own accord with proper battery-power, I felt that imagination was carrying an overload. However, Zebediah acknowledged that the thing was very pretty, and when operating as planned must be decidedly interesting. He thanked me for taking so much trouble to amuse his "idle hour," and seemed to expect that I would now shove along to the next citizen I designed to favor.

It was an awkward moment; still, with a lump in my throat so large that it seemed a miracle the throat could hold it, I managed to pronounce a statement of its great value for advertising purposes, as demonstrated by Uncle George's experience in New York; how his store would be thronged with watchers of the marvel, a given percentage thereof buying his wares. Zebediah was a perfect audience, in that he listened without a word; but there was a quizzical smile on his face that disconcerted me. Father was right, it didn't look in the least like money; and when at last I'd instructed Crowell how to run his business at greater profit, and approached the subject of my modest share thereof, what was left of the prospective $79,920.00 sank with all on board, leaving on the surface, like a single bubble, the timid query. "W-wouldn't you be willing to g-give me something for the use of it?"

Instead of shattering my hopes, Zebediah was kind enough to dismantle them gently, being able to spare the time because he was also occupied with his string-ends; they say he never gave away his time without extracting the nutriment first in some such way. Eye-catching devices might go in New York, he said, where there were so many strangers, but in our town the need was rather for something to get rid of people who didn't come to buy; and he mentioned with some feeling the names of a line of inveterate chair-warmers who spent all day in his store but never spent anything else.

Skilled by long practise in avoiding persistent drummers, Zebediah, having relieved his mind, proceeded to get rid of me with bewildering dispatch. Unstinted in his praise of the Sailing Boat, he predicted a great future for it—in New York, of course, where conditions were so favorable. He pronounced my father a lucky man for his opportunity to finance the undertaking,

only I must be careful not to allow him too large a share of profits for his aid—something adequate, of course, but strictly limited in time, because frequently parties let themselves in for very oppressive conditions by neglecting that precaution. And so, good day, and I must be sure not to forget him when in the market for young men's snappy furnishing-goods.

He talked me out of the store, and I dript along home primed to impress father with visions of living high at the Hoffman House, or the Astor, or another of the then smart hotels, while we treated haughtily with suppliant tradesmen in figures that made my $79,920.00 blush with humility.

The old adage says that it's darkest just before the dawn. Turn it inside out (as you can do with any genuine adage) and it's equally true that it's brightest just before a total eclipse; and my eclipse was approaching, strictly on schedule time. On hearing my story, father was imprest all right, but the pressure was on the wrong spot. He was a deliberate man, and before replying he seemed to struggle with an emotion of some sort. Having conquered it and rectified the frontiers, he spoke as one intending to give an example of self-restraint: he said he was glad to know there was one thing that meddling old hypocrite Crowell would part with freely, even if it was only hot air; that the home town exclusively was to be favored with my destinies for many years yet; that my immediate future was concerned with splitting up a few slags for the morning's fire; and finally, would I please learn something in school conducing elsewhither than to such nauseating nonsense?

From these neatly worded expressions I gathered that the great merchant's guidance of our family affairs had not met with father's heartfelt gratitude. With an excellent running-start, my $79,920.00 was unquestionably beating it; and nothing has occurred since to make me doubt that it is going yet.

THE SUBMARINE AND KINDRED PROBLEMS.

(*Continued from page* 524)

In case the water is more than 200 feet in depth a submarine must be kept in motion to obtain steerage way in order to hold its proper depth of submergence. This speed may not exceed 4 or 5 miles per hour, but to remain submerged, and at the same time unobserved, the water must be at least 60 feet deep.

The latest type of submarine which is being used abroad has a surface speed of at least 17 knots per hour and a submerged speed of probably less than 10 knots. The superior gun fire from the merchantman which has been properly equipt would make it necessary for the submarine commander to obtain his observations, such as would permit accurate aiming of the torpedo, during the very brief interval of time required to come to the surface for observation thru the periscope and to again submerge.

If running near the surface, the periscope might be raised, a quick observation taken, and lowered again within 30 seconds. If, however, the submarine is on the surface and hatches uncovered, from one to four minutes will be required to completely submerge, depending upon circumstances.

A submarine of recent type probably has a total radius of action of as much as 8,000 miles when traveling at a moderate cruising speed of from 10 to 11 knots, and may remain away from its home-base for as much as one month, without requiring either fuel or other supplies during this period.

This type of submarine may have as many as three periscopes, two conning towers and two rapid-fire guns attached to the upper portion of its hull.

The vessel is steered by very efficient gyroscopic compasses, which are unaffected by extraneous magnetic or electrical influences.

(a) Means for Discovery

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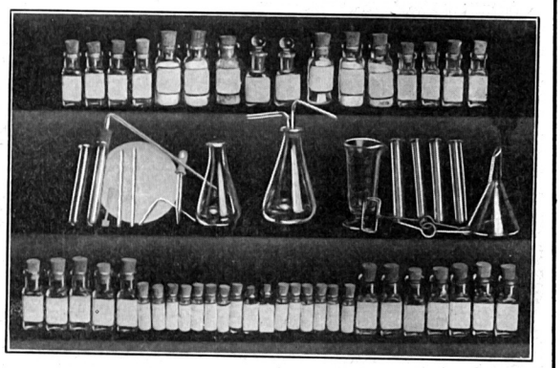

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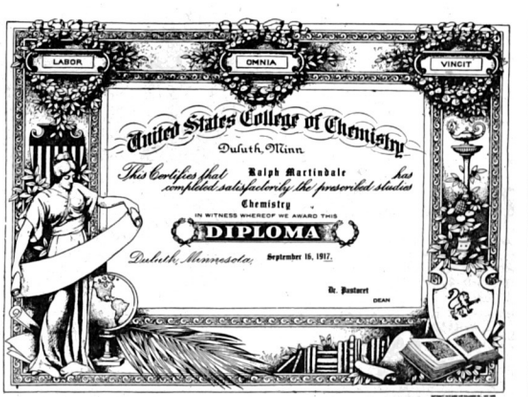

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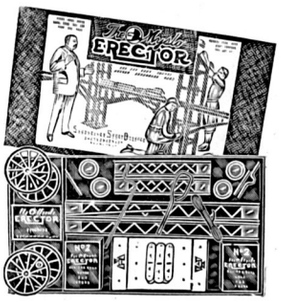

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are unable to fly far out to sea where the submarines are now most active. Mother ships for carrying and launching aeroplanes might be used in this connection, but there are only a small number of such ships in operation and the construction of others under present conditions is necessarily a slow process.

Various *sound-recording* devices, intended to locate surface-vessels, submarines, and even moving torpedoes, are now being carefully tested. Water is an excellent conductor of sound, and the development and improvement of such apparatus offers a promising field for inventive endeavor to those who possess adequate scientific training and laboratory facilities.

Many devices are suggested which depend upon optical means of detection, such as special forms of telescopes and field-glasses to be mounted on ships, or on scouting vessels. Many special forms of search-lights and projectors have been suggested. The fact that a moving topedo leaves in its wake a stream of air-bubbles caused by the exhaust-air from its propelling engines, offers, under favorable conditions, one means for discovering the approach of a torpedo. This evidence is, however, difficult to detect in a rough sea or at night, and, furthermore, the bubbles do not reach the surface of the water until after the torpedo has traveled onward a distance of from 50 to 200 feet towards its target.

The dragging of trawls, or nets, by special guard-boats, not only with the view of locating submerged submarines but also to sweep up floating and stationary mines, is frequently suggested. Under certain conditions this operation is practicable and effective.

It will be seen that each of the above methods, however useful, has its limitations, and scientists and inventors should apply themselves not only to the task of improving these, but also of finding supplementary methods and devices.

(b) Protection of Cargo-Carrying Ships by Nets or Screens

Many designs of such devices are suggested, and most of them are intended to be attached to the hull of the vessel to be protected. Many other suggestions along these lines, and differing only in some of their minor characteristics from the foregoing, have been received by the Board. Up to the present time not one of these proposals involving screens of any kind has received the approval of the Navy Department or of the Merchant Marine. The principal objections offered to these devices are that they are heavy, difficult to hold in position, unmanageable in a heavy sea, and that they interfere with the speed and with the ability of the vessel to maneuver. The undeniable evidence which has been accumulated during the past few months of submarine activity has demonstrated that the immunity of a vessel to submarine attack is dependent very largely on its speed and also its maneuvering ability. The percentage of vessels having speeds of 15 knots or more which have suffered from submarine attack is very small, while the losses of slow vessels, whose speed is less than that of a submerged submarine, is practically one hundred per cent of those attacked. Many of the suggested devices would prevent the launching of life-boats or rafts from the vessel to be protected. It is barely possible, however, that there may be developed some form of this general plan which will be found practicable. In no other field have so many suggestions or so many duplicate inventions been presented to the Board.

(c) Protection Thru Invisibility

The point of lookout on a submarine being close to the water, the position of a vessel at a distance can only be determined by observing its smoke, which floats high in the air. Improved smokeless combustion is therefore desirable. Relative invisibility may also be afforded by methods of painting.

(d) Destruction and Blinding of the Submarines

A *rapid-fire* gun is effective when the submarine is seen within accurate range of the gun; but the target is so small that it is difficult to hit.

The *powerful effect* of any *submarine explosion on all neighboring bodies* provides a simple means of *destroying or crippling* an undersea boat. Once it has been even approximately located, the setting-off of a heavy charge of high explosive, well submerged in the vicinity of the submarine, will bring about this result.

In certain areas, a quantity of heavy, black *petroleum* or similar substance which will float on the surface of the water has proved an effective means of clouding the optical glass in the periscope's exposed end.

Under favorable conditions of wind and position, many vessels have saved themselves from torpedo attack by the production of a *smoke screen.* This may be formed either by incomplete combustion of the oil used for fuel by most naval vessels, or it may be created by burning chemicals, such as phosphorous and coal tar, or mixtures in which both of these and other materials are used.

After hiding itself from the submarine in a cloud of dense smoke, the vessel, if possest of sufficient speed, may be able by a quick maneuver to change her position and escape before the submarine is able to discharge a torpedo.

MINES AND TORPEDOES FOR NAVAL OPERATIONS

(a) Mines

Ever since the first use of gunpowder in the prosecution of war, mines and torpedoes have received great attention both from the warrior and the inventor. Mines are either *fixt* or *floating.* The *fixt or stationary submarine mine* is fired by contact, electricity, timing device or fuse. Such mines, which are extensively used by all navies, are rugged in design and may contain large charges of explosives. They are placed in position by especially equipt mine-laying vessels. Such a mine is provided with an anchoring device.

Floating mines differ from fixt mines in that they are unanchored, and, unless guard boats are at hand to warn friendly vessels of their proximity, may be as dangerous to friend as to foe. Such mines must be, according to laws of war, designed to become inoperative within a few hours after being set adrift.

(b) Torpedoes

The *modern submarine torpedo* is about 20 inches in diameter and 20 feet in length: is *self-propelled; is not steered by magnetic means;* and keeps a fairly accurate course for several thousand yards at an average speed of more than 30 *miles an hour.* Its *weight is approximately a ton and a quarter;* and, when traveling at normal speed, possesses great *momentum*—in fact, in one case, when the high explosive charge in the "warhead" failed properly to detonate, the body of the torpedo pene-

trated the steel hull of the ship attacked. Torpedoes are also provided with means to more or less effectively cut through screens, nets, or guards placed in their path.

A torpedo is projected from a submarine or other vessel by means of a special form of tube or gun. A small charge of gunpowder or comprest air is employed to start the torpedo, after which—if of the usual self-propelling type—it is driven through the water by its own comprest air motor, the air being supplied from a strongly built reservoir within the body of the torpedo itself. The torpedo is kept upon its course by a *gyroscope* steering mechanism, which is *immune to outside magnetic disturbances.*

The detonation of the torpedo is accomplished through a mechanism placed within its warhead; and if the torpedo is either *abruptly diverted from its course or is checked in its forward motion, the firing device,* which is *operated by arrested momentum* rather than by any form of a projecting firing-pin, instantly ignites the heavy charge of explosive contained within the warhead. The *explosion,* if it takes place *within twenty feet of the vessel,* will usually *rupture the ship's plating,* because of the terrific blow transmitted through the water from the point of the explosion to the ship's side. The *depth* at which a torpedo travels is usually between 12 and 15 feet below the surface.

Confining the Submarines

The question as to why submarines are not destroyed before they reach the open sea is a most natural one, and the best answer which it is possible to give, according to the officers of our Navy and those of the foreign commissions who have visited this country, is as follows:

The submarine bases are very strongly protected by land batteries, aeroplane observers and large areas of thickly mined waters extending to such distances that the largest naval gun cannot get within range of the bases. In spite of these protections, there is now going on a continuous attempt on the part of the Allied navies to entrap or otherwise defeat the submarines as they emerge from the protected areas. Nets are laid and as promptly removed by the enemy, whose trawlers are in turn attacked by our destroyers. The design of these nets and the detailed arrangement of their fastenings and attachments offer a broad field for invention, but it should be remembered that they must be capable of being used in waters in which there is a tidal current running from two to five miles per hour. Many suggestions for "bottling up" these bases have been offered, but, as will be realized, it is not desirable to publish information which would indicate even in the smallest degree this country's plans.

Ships and Shipbuilding

Many suggestions are made for ships of *unusual form* to provide for safety in case of a torpedo or mine exploding near or against the hull. Most of these plans are an elaboration of the usual watertight bulkhead construction now required as structural design for all modern ships.

The *multiplicity of waterfront compartments* in any hull design tends to add to the vessel's *safety.*

The *modern tank steamer* used to carry fluid cargoes, such as petroleum products or molasses, is a *good example of this design,* which has been in general use for many years.

The explosion of a nearby submarine mine or torpedo frequently tears great rents in the ship's plating, in some cases opening a jagged hole ten feet or more across, but the destructive effect on the hull of a ship caused by the explosion of a mine or torpedo may be greatly diminished by special hull construction.

General Instructions to Those Offering Suggestions to the Naval Consulting Board

A very large proportion of the letters and plans that are received describe devices or schemes which are obviously impracticable or which show no novelty or improvement as compared with existing methods. After the elimination of these, the more meritorious inventions are submitted to the various standing committees of the Board for examination. If an invention receives the approval of a standing committee, it is presented to the Board with a favorable report and, if then again approved, it is forwarded to the Navy Department with the endorsement of the Board.

The fact that inventions, plans and devices must be forwarded to the various departments of the Board for examination makes it essential that everything be presented in writing.

Communications should be addrest: Thomas Robins, Secretary, Naval Consulting Board, 13 Park Row, New York, N. Y.

Presumably the Government intends to pay for inventions which it adopts, but as yet no specific provision has been made by law for this purpose.

Statement of the Ownership, Management, Circulation, etc., Required by the Act of Congress of August 24, 1912, of THE ELECTRICAL EXPERIMENTER, publisht monthly at New York, N. Y., for Oct. 1, 1917. State of New York, County of New York, ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Hugo Gernsback, who, having been duly sworn according to law, deposes and says that he is the Editor of THE ELECTRICAL EXPERIMENTER and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc, of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, The Experimenter Publishing Co., 233 Fulton St., New York City; Editor, Hugo Gernsback, 233 Fulton St., New York City; Managing Editor, Hugo Gernsback, 233 Fulton St., New York City; Business Manager, Hugo Gernsback, 233 Fulton St., New York City.

2. That the owners are: The Experimenter Publishing Co., 233 Fulton St., New York City; Hugo Gernsback, 233 Fulton St., New York City; Sidney Gernsback, 233 Fulton St., New York City; Mrs. K. Hymes, 233 Fulton St., New York City; H. W. Secor, 233 Fulton St., New York City.

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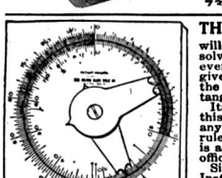

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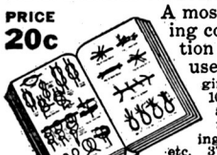

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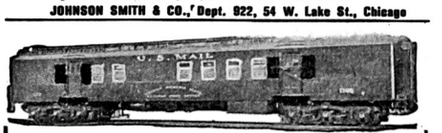

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FOR SALE—Build your own motor or generator. Can furnish new high class 4"x3" armature with set of brush holders and six (6) brushes for $2. Can be used for 6 to 12 volts, shaft turned for standard E 17 Norma ball bearings and threaded ⅝"—18 thread for pulley. A. D. Adams, 422 Park Road, Ambridge, Pa.

ELECTRICIANS and ARMATURE WINDERS. Send $1.50 for 16 blueprints of motor windings, 10 A. C. single, two and three phase and 6 D. C. Or 20 A. C. 6 D. C. and 6 rotary converter drawings for $2.25. Winding made easy. Superior Electric Co., Lock Box 1372, Pittsburgh, Pa.

Scientific Exchange Columns

UNDOUBTEDLY you have at the present time some things for which you have no further use. Do you wish to exchange them for something for which you have immediate use? There is no surer and quicker way to do this than by advertising your articles in these columns. The *Very* people, the *Only* people, who could possibly have a use for your things read this journal. More than 75,000 interested people will see your ad. It is furthermore the cheapest advertising medium for you in the country. Dealers' advertising accepted in Opportunity Exchange columns only.

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We reserve to ourselves the right to refuse any advertisement which we consider misleading or objectionable. Advertisements for the January issue should reach us not later than November 25th.

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WANTED—Aviation motor; price must be low. Would consider a wrecked motor. H. A. Margreiter, 120 E. Harrison, Kirksville, Mo.

FOR SALE—Storage battery, stamp collection, X-ray tube, wireless and high frequency apparatus. Robert Eccles, 201 Genesee St., Auburn, N. Y.

SACRIFICE — Large magnificent commercial type radio cabinet. Panel operated. 5,000 miles, ⅛ K. W. Cost $150, sell $80. Other things. Write L. Hamilton, 378 Fairmont Ave., Oakland, Cal.

MOTORCYCLE ENGINE, twin cylinder complete with magneto, carburetor, muffler and clutch. Good running condition. First $25 takes it. Edw. J. French, Peekskill, N. Y.

NEW 32-inch $30 Bass Drum for $10. Also 17-inch $14 Snare Drum for $5. Clarence Osborn, 97 Watkins Ave., Middletown, N. Y.

BARGAIN—I will swap my large loose coupler for a storage battery. Robert Halverson, R-1, Kasota, Minn.

BARGAIN—Two Meccano sets worth $7.50. First $3.25 gets both sets. Want, bicycle motor attachment; Smith motor-wheel preferred. Russell Murrow, Mitchellville, Iowa.

WANTED—Bench lathe and accessories. State size, make, condition and price. Also, what will you take in trade? W. Rex B. Sutch, Clayton, New Jersey.

WILL SELL—Sturmeyarcher 3 speed coaster-brake in wheel, $6. ¾ size violin, $5. Diabolo, 50c; Semi-automatic wireless key, $2; ½" coil, $2; Punching bag, $1.50; 4 magnet Generator, $1. R. O. Miles, Wyonet, Ill.

WANTED—All back numbers Q S T to January 1917. Sale or Exchange—8,000 meter undamped coupler, 1600 Navy coupler all taped. What do you offer? Louis Krieg, Jr., 134 No. School, Gloversville, N. Y.

FOR SALE CHEAP—1 6 volt K & D motor No. 5, $5.50; 8 point Rheostat, for small motors, 50c; Reversing Switch, 50c; 3 Telephone Transmitters, each 75c; ½ lb. No. 36 Enamel covered wire, $1; Electric Whistle, 40c; "Solar" 6 volt 70 amp. Storage Battery, $7.50; 3-way Transformer, 6, 8, 14, 80c; 10 ohm Magnet, 80c; 80 ft. ⅛" square rubber, $2.50; 3¼x5½ Printing Frame, 20c; 1 stick of Selenium, 30c; ½ coil spring, new, 30c; Two 20 ohm Standard Relays, ea. $1.25. William J. Murdock, 322 South Main St., Clinton, Ind.

WANTED—All kinds of photography goods. Have some fine things to exchange. A. Hofman, 382 Cornelia St., Brooklyn, N. Y.

SACRIFICE—Magnificent Cyclopedia Applied Electricity, write enclosing stamp. Warnecke, Jr., 23 E. 88th, New York.

EXCHANGE OR SALE—Superior Phones, $4; E. I. Vario Selective Coupler, $4; 300 ft. 4 strand Antenium Wire, $2.25; Two 10½" Insulators, 60c; Four 5½" Insulators, 75c; Junior Fixed Condenser, 30c. Above articles never used. Also E. I. Commercial Detector, 75c. Have 25 Boy's books. Want, 110 volt motor, must be good condition, or cash. Write if interested. J. Raymond Stafford, 103 Fisher St., Marquette, Mich.

CYCLECAR material! 4 H.P. motorcycle engine, magneto and carburetor; steering gear complete; front and rear axles; 4 full eliptical springs; 2 foot levers; 4 wire spoked solid rubber tired wheels. Sacrifice, $30, R. R. CROWE, Box 126, Baraboo, Wis.

WANT—½ to 1 H.P. 500 volt motor or generator, Weston or Keystone portable ammeter 0-50 amperes, voltmeter 0-150 volts. Will buy for cash or exchange for radio apparatus. Have an excellent Keystone milliampere meter; fine for research work. Samuel Cohen, 1936 Pitkin Ave., Brooklyn, N. Y.

"WANT TO SWAP"?

Do you realize that these "Scientific Exchange Columns" are the World's most renowned "Swap" market? "THE ELECTRICAL EXPERIMENTER" prints 80,000 copies of this issue; that means that at least 160,000 readers see this page and probably a great many more. Our readers who advertise here seldom advertise the same thing twice—usually within five days after the issue is out the advertised article has been sold, or swapped. The many testimonials which we print here from time to time are ample proof of the almost miraculous pulling power of these columns.

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And remember this fact: The U. S. Postal Laws protect you. No one can "do" or cheat you. Of 3,495 "ads" published in these columns during the past five years, only twelve complaints were reported to us, and each and every one was adjusted to the full satisfaction of the complainant.

It matters not if you have old books or magazines, a kodak, electrical or chemical apparatus, scientific instruments, bicycles, typewriters, moving picture machines, air rifles, watches, structural toys, etc., etc. All these and countless others can be speedily disposed of here. Try it and be convinced.

329 Elm St., Penn Yan, N. Y.

Gentlemen:—I wish to tell you of the successful results I obtained from my ad in the "E. E." Before the publication date I received an inquiry and ever since they have been "pouring" in at the rate of several each day.

To date, I have received sixty-three inquiries and have disposed of most of articles advertised.

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Thanking you for your promptness in inserting my ad, and wishing a long and prosperous "life" to the ELECTRICAL EXPERIMENTER, I remain

Yours truly,

Lester Chisholm.

WANTED—Omnigraph in first-class condition, 2 inch spark coil, and guaranteed 2000 or 3000 mile receiving set complete with aerial. Ivar Wallin, Chignik, Alaska.

TWIN cylinder motorcycle engine in good condition, complete with magneto, carburetor, clutch and muffler. $25 takes it. Edward J. French, Peekskill, N. Y.

CHEMICALS—Set of fifteen with test tubes, alcohol lamp, etc., for $1.00. Electrical apparatus. Drafting instruments. 25 copies American Boy, 50c. List for stamp. Lester Chisholm, Penn Yan, N. Y.

SACRIFICE—½K. W. transmitting set complete. Packard transformer, glass plate condenser, Murdock 0.2., Klitzen rotary gap on marble base, key on marble base. Everything good condition, $22.50. Alex. Schaff, R. R. 11, Franksville, Wisc.

FOR SALE—4-blade ceiling Fan. 1 computing scales. Write, Louis Elfers, 605 Grandview Ave., Muscatine, Iowa.

HUNTING BARGAINS? Then send sixteen dollars for my new high-class receiving outfit or eighteen dollars for my No. 6 Remington typewriter. Particulars for stamp. Fay Williams, Huron, Ind.

REGENATIVE SET, including Audion, Range 150-850 meters, $20. Want ½ Kilowatt transformer, condenser. McMurdo Silver, 340 West 57th St., New York. Phone Columbus 1628.

BRAND NEW DeForest Round Amplifier Bulb, $4, Tubular Type $3. Peerless Detector, $1.50. Lots of bargains, write. R. Cuthbert, 385 E. 184th St., New York.

SELL—Large Size Presto-Lite Tank with brackets, $9. Two cylinder, four horse-power automobile steam engine, $10. Clarence Vaughan, Middletown, N. Y.

FOR SALE—Complete Wireless Outfit, ¼ K.W. Transmitter, $20. Printing Press, 5x8, 10 fonts type, $25. Typewriter, $10. Particulars, stamp. Jensen, Boscobel, Wisc.

PRACTICALLY NEW I. C. S. Electrical Engineering, Electric Railways Courses; two spark coils 7x2½, 7½x2 for $18. E. Holmes, 12 Walnut Park, Roxbury, Mass.

FOR SALE OR EXCHANGE—Set of chemicals and apparatus for twin cylinder motorcycle engine. Write for particulars. Robt. Shank, 521 So. Jefferson St., Dayton, Ohio.

FOR SALE—Chemical Laboratory—Complete line of chemicals for analytical also Experimental and Photographic purposes—Practical apparatus and Reagent bottles—Value $40. For particulars write to N. H. Parex, 247 Pearl St., N. Y.

EXCHANGE—My $40 Violetta complete. Want Omnigraph in first-class condition, even exchange, or what have you in wireless apparatus? Geo. A. Chandler, 500 N. Clark St., Chicago, Ill.

WANTED—Copy of book "Michael Faraday, His Life and Work" by Sylvanus Thompson. Also an ohmeter of the Roller-Smith type or a Wheatstone bridge; must be in first-class condition, and include galvanometer. H. W. Secor, c/o ELECTRICAL EXPERIMENTER, 233 Fulton St., New York City.

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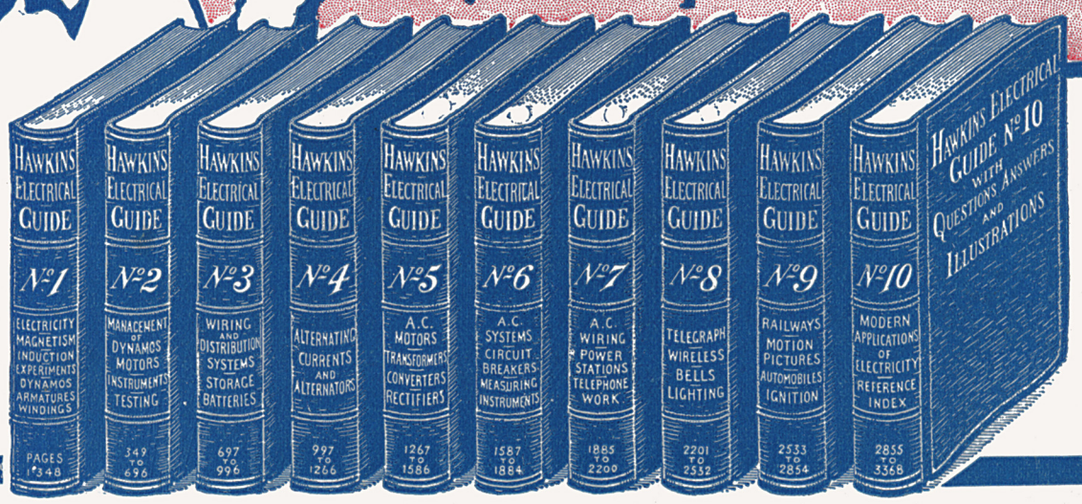

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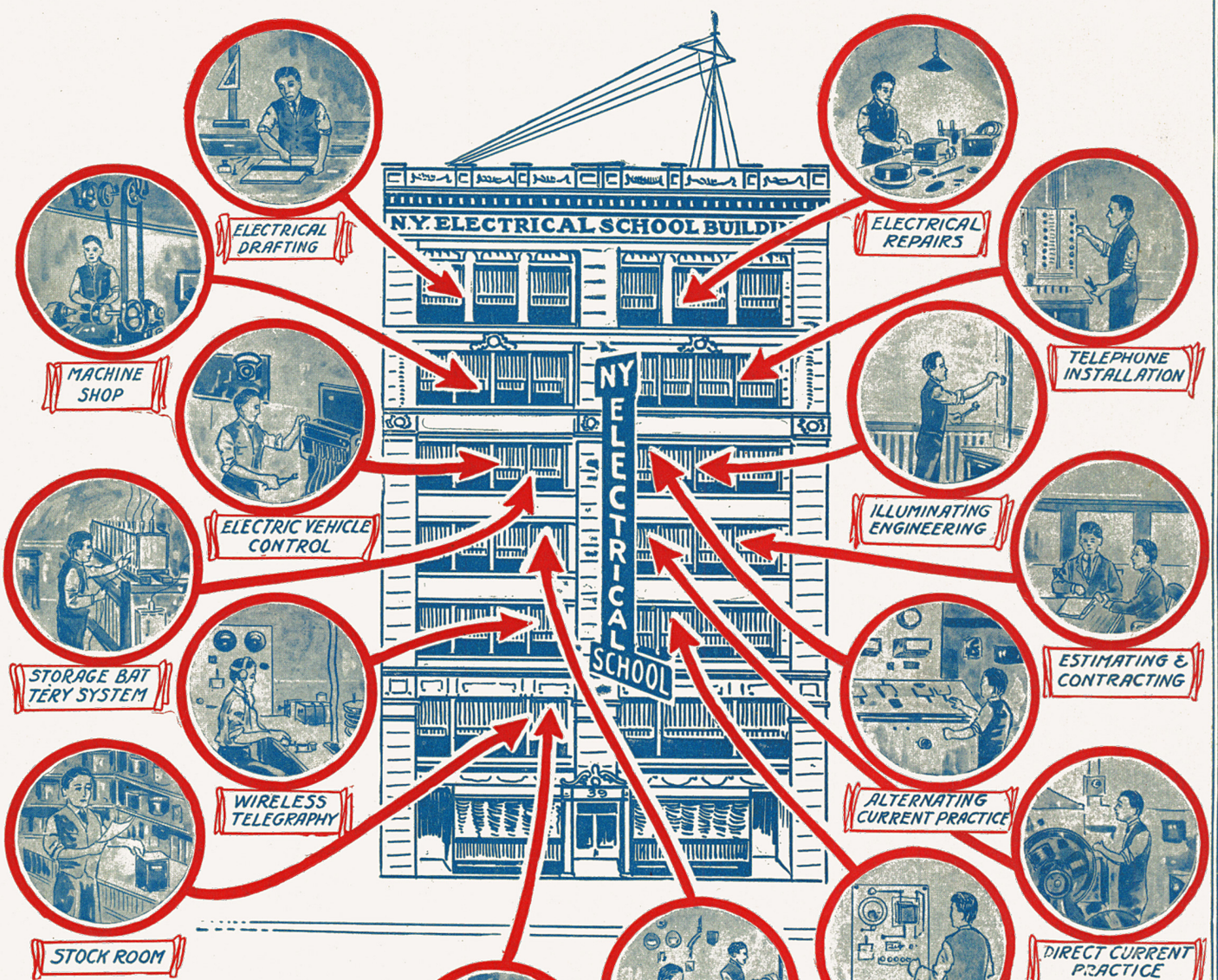

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